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DRAWN BY JOHN CHARLTON. FROM A SKETCH BY L. TRELYVEN CREOLE.

At a point between Sutna and Manikpur the engine surprised a couple of good-sized tiger cubs that had been amusing themselves on the line. They showed no alarm, but, just as if they knew the speed of the train to a nicety, cantered along in front of the engine for a couple of hundred yards or so, and then turned off to the right and left.

TIGERS ON THE LINE—AN INCIDENT ON THE EAST INDIAN RAILWAY.—FROM THE GRAPHIC.

SHALL CUBA BE FREE?*

On October 28, 1492, Columbus discovered Cuba. His son Diego, in 1511, fitted out an expedition consisting of 300 men, and dispatched it under command of Diego Velasquez to take possession of the island and begin its colonization. According to all early writers, the Siboney Indians, who possessed this noblest of the Antilles, were amiable, innocent, hospitable, and graceful. Velasquez lost no time in despoiling them of their possessions, trampling on their natural rights, and butchering those who resented his brutal domination. The Chief Hatuei, who saw his people so cruelly enslaved, struck back, and Velasquez burned him at the stake. Between the savage conceptions of immortality which Columbus declares these gentle savages to have possessed and the new doctrines of salvation which Spanish conquerors never failed to confide to those whom they were about to roast, Hatuei must have experienced a certain confusion of ideas; but his primitive soul so revolted at the cruelty of his tormentors that he said: "If there are Spaniards in heaven, I prefer to go to hell." For about four hundred years Spain has owned Cuba, and she has governed it, with certain honorable exceptions, on the lines of oppression and exhaustion laid down by Diego Velasquez.

Slaughter and deportation for the slave markets of Spain within fifty years so reduced the Indian population—variously estimated from 500,000 to 1,000,000—that importation of African slaves was authorized, and thereafter continued, either openly or clandestinely, until within forty years of the present date. Coarse greed underlay the enslaving of both Indians and Africans, and the oppression borne of that greed, and practiced on peoples whom it was safe to maltreat, became so ingrained in the class that governed Cuba that to-day in this late year of our Lord, after the last Siboney sleeps in his grave, and Spain has been forced to abolish her African slavery, she must needs hold over her own flesh and blood in Cuba the same old iron rod of oppression. So exasperating is that rod, so cruel its strokes, that Cuba is again in the throes of a bloody insurrection. . . .

With the exception of a few modern sugar estates, largely of foreign ownership, and some almost comic railways, Cuban industry is back in the period of the Roman empire. The island has long ceased to pay a legal, above board profit to Spain, but yearly piles up a mountain of deficit. To merchants in Spain, from whom Cuba is by the tariff forced to buy, there is profit; to the Spanish tradesman in Cuba there is fortune; to the army of blackmailers there is wealth. All profit and all advantage go to Spain. Cuba only suffers and grows poor. She has moreover the bitterness of seeing that the host of almost hostile Spaniards in the island, both official and commercial, are there only to despoil her. She sees her revenues imposed and spent by Spain, and the private gains of the army of aliens carried off when greed is glutted.

Nowhere within the limits of western civilization is there a more favorable spot for the swift, almost boundless, development of vast popular wealth. Rich beyond description, beautiful as Eden, Cuba, with only a tenth of its area occupied, and its resources as yet hardly touched, lies bankrupt under the coarse heel of a despot too blind to see even his own advantage.

Half a century ago, by a liberal fiscal policy and decently good administration, even denying constitutional rights and by means of her "special laws," Spain with supreme ease could have placed Cuba in opulence and turned the old golden gulf-stream again toward her shores. But with that towering vanity which has replaced her just national pride, she scoffed at the appeals of Cuba, and went on in that career of conceited folly which has reduced her from the loftiest position in modern European history to the pitiable insignificance of to-day, and left for Cuba only ruin and rage. It is now too late. Spain can never win back the heart of Cuba. She can never again make a lasting peace. It is war till Cubans are free or dead. Flung from the continent of America for her intolerable oppression, Spain lags in this hemisphere as the mere embodiment of tyrannical greed. From a historic distance there is a kind of picturesque Roman grandeur in her armed and bannered conquerors, trampling down barbarians and putting them to the sword and cross; but no haze of time or distance will ever soften the miserable spectacle of her last days in Cuba, oppressing and blackmailing her fairest daughter. . . .

Prior to the present insurrection four others have occurred in this century: The conspiracy of the Black Eagle in 1829, the Lopez conspiracy in 1848-51, the Pinto conspiracy in 1855, and the bitter ten years' war, 1868-78. . . .

It is worth while to advert now to the manner in which Spain, in maintaining her military government, has treated the persons and personal rights of Cubans. For example: the alleged slave conspiracy of 1844 was met by the immediate placing of a court martial at Matanzas, the scene of the trouble. No incriminating evidence was obtainable under ordinary examination, so the court went back to the fine old methods of the Inquisition, and followed the example of Torquemada. Slaves, colored freedmen, and whites were stretched face down on ladders, and their naked backs lashed till they satisfied their torturers. As a result 1,846 people were sentenced, some to death, others to banishment, others to hard labor for various periods. Any Cuban patriot may find himself under a tacit ban. Let us suppose that he is a suspected person: he is watched, and if suspicion rises to a sufficient degree of certainty, he is arrested; and now comes one of the neatest and most effective methods of disposing of a suspect among the extraordinary wealth of expedients known to Spanish military law. Evidence being slight, the prisoner may be ordered removed under guard to some other place of safer keeping, and is liable to be shot by his soldier guard if he attempts to escape. So common has this been that a wink of his superior to the guard is as good as a nod. When the prisoner stumbles, or sneezes, or looks out of one eye—he is killed, and a report is rendered, "Shot while attempting to escape."

In the 1868-78 war, the insurgents were never accorded belligerent rights by any power strong enough to take Spain by the throat and force her to conduct operations under the reasonable humanities of modern war. . . .

The war having begun, General Count Valmaseda, April 4, 1869, published the following proclamation:

"Inhabitants of the country! The reinforcements of troops that I have been waiting for have arrived; with them I shall give protection to the good, and punish promptly those that still remain in rebellion against the government of the metropolis.

"You know that I have pardoned those who have fought us with arms; that their wives, mothers and sisters have found in me the unexpected protection that you have refused them. You know, also, that many of those we have pardoned have turned against us again.

"Before such ingratitude, such villainy, it is not possible for me to be the man that I have been; there is no longer a place for a falsified neutrality; he that is not for me is against me; and that my soldiers may know how to distinguish, you hear the order they carry:

"1st. Every man from the age of fifteen years upward, found away from his habitation (finca) and who does not prove a justified motive therefor, will be shot.

"2d. Every habitation unoccupied will be burned by the troops.

"3d. Every habitation from which does not float a white flag, as a signal that its occupants desire peace, will be reduced to ashes.

"Women that are not living at their own homes, or at the houses of their relatives, will collect in the town of Jiguani, or Bayamo, where maintenance will be provided. Those who do not present themselves will be conducted forcibly.

"The foregoing determinations will commence to take effect on the 14th of the present month.

"El Conde de Valmaseda."

Spanish tyrants are always deeply Christian, so that it can hardly be supposed that Valmaseda, in using solemn words of the Saviour, did so unconscious that the source of his phrase is the source of divine compassion to men.

A month later, Mr. Fish, then Secretary of State, correctly branded this proclamation as "infamous," and wrote in a letter to Señor Lopez Roberts (Spanish minister to the United States):

"In the interest of Christian civilization and common humanity, I hope that this document is a forgery. If it indeed be genuine, the President instructs me in the most forcible manner to protest against such mode of warfare."

We have not forgotten the wanton butchery of Americans in the Virginius affair. It remains of value as a proved example without which we should be slow to believe that Spanish generals habitually shot insurgents captured in battle, as in fact they did. A published record of the Spanish barbarities of the war gives in detail a list of 2,927 "martyrs to liberty"—political prisoners executed during the war—and of 4,672 captured insurgents, whose fate has never been made known. There were 13,000 confiscations of estates, 1,000 being those of ladies whose only crime was the love of Cuban liberty.

The experience of American newspaper correspondents, like O'Kelly, in rebel camps and Spanish prisons, confirms the revolting character of the Spanish conduct of the war; and there are extant letters of Spanish officers which throw gleams of light into the darkness of the period. A specimen or two are enough:

Jesus Rivocoba, under date of September 4, 1869, writes:

"We captured seventeen, thirteen of whom were shot outright; on dying they shouted, 'Hurrah for Free Cuba! hurrah for Independence!' A mulatto said, 'Hurrah for Cespedes!' On the following day we killed a Cuban officer and another man. Among the thirteen that we shot the first day were found three sons and their father; the father witnessed the execution of his sons without even changing color, and when his turn came, he said he died for the independence of his country. On coming back we brought along with us three carts filled with women and children, the families of those we had shot; and they asked us to shoot them, because they would rather die than live among Spaniards."

Pedro Fardon, another officer, who entered perfectly into the spirit of the service he honored, writes on September 22, 1869:

"Not a single Cuban will remain in this island, because we shoot all those we find in the fields, on the farms and in every hovel."

And again, on the same day, the same officer sends the following good news to his old father:

"We do not leave a creature alive where we pass, be it man or animal. If we find cows, we kill them; if horses, ditto; if hogs, ditto; men, women or children, ditto; as to the houses, we burn them; so every one receives his due—the men in balls, the animals in bayonet thrusts. The island will remain a desert."

Valmaseda himself paid a visit to the plantation home of the Mora family, and, there being no male patriots on whom to wreak his lust for blood, butchered and burned the sisters Mora and left their home in ashes. A mere enumeration of authentic cases of Spanish inhumanity in the last insurrection would fill volumes and exhibit one of the blackest episodes of history. . . .

Cubans are under no delusion as to the fateful step they have taken; the men who survived the scourge of the ten years' war, in rushing to arms again, act in full consciousness of what they are doing, and willingly face the cruel odds. If this were a first effort to acquire freedom, it might be attributed to the over confident enthusiasm of a brave people inexperienced in war and its train of suffering and grief, and ignorant of the combination of money, material, and men their enemy can hurl against her. But these are the very people who half a generation ago fought ten years, and felt the shock of 200,000 Spanish soldiers, and suffered as no modern combatants have done. They enter this war as bravely as before, but with eyes open and with memory loaded down with visions of agony and blood. Of that adoration of liberty which is the only sure foundation of modern representative government, this insurrection is as pure and lofty an example as the course of human history can show. . . .

Impoverished by centuries of financial oppression, the Cuban patriots are poor, their slender resources are the sum of innumerable small contributions. Few in number, empty of purse, they stand within this tight-drawn ring of Spanish fire. Cut off from any but dangerous and clandestine introduction of arms and medicines; lacking supplies to form a base; with not a cent to pay a single soldier or officer of their little army; with only a skeleton medical corps—in short almost nothing to make war with—these brave souls are facing, not death only, but Spanish death. The region under revolution is one great graveyard of those fallen in the ten years' revolt, yet Cubans are undaunted by the numbers or resources of their foe. Besides this far-reaching patience of valor a single act of heroism like Thermopylæ is pastime; compared with the raggedness, hunger, and privation which Cubans bravely choose to accept, Valley Forge was a garden party. For ten years these same men with the same slender resources held the arms and pride of Spain at bay, and then capitulated to promises which were made only to be broken.

Of Spain the insurgents have no fear; but if the United States rigorously prevents the shipment of arms and munitions from our shore, we can discourage, we can delay, the triumph of patriotism, but in the end we cannot prevent it. In this war, or the next, or the next, Cuba will be free. Although these men are our near neighbors, although we are to them the chosen people who have won independence and grown great in freedom, yet they have never made the slightest appeal to us for active aid in their struggle. They expect no good Samaritan offices. They look for no gallant American Lafayette to draw sword for them and share the penury and hardships of their camps. They ask nothing. But I happen to know that they are at a loss to comprehend how a great people to whom heaven has granted the victorious liberty for which they are fighting and dying, should let months pass in cold, half silence, without one ringing "God speed!" to cheer them on into battle.

It is doubtless explicable enough that a people whose own business is so essentially materialistic as ours, and who mind it so absorbedly, should remain carelessly ignorant of the real Cuban question and the moral attitude of the island people; but is it fair, is it generous, is it worthy of the real blood of freedom that still flows from the big American heart? Already a change is coming, and isolated expressions of genuine sympathy are becoming frequent. The time will come, and that not long hence, when the voice of America will ring out clear and true.

The Cuban war hangs before us an issue which we cannot evade. Either we must stand as the friend of Spain, and, by our thorough prevention of the shipment of war supplies to the insurgents, aid and countenance the Spanish efforts to conquer Cuba into continued sorrow, or we must befriend Cuba in her heroic battle to throw off a mediæval yoke. Let us not deceive ourselves! Spain alone cannot conquer Cuba; she proved that in ten years of miserable failure. If we prevent the sending of munitions to Cuba, and continue to allow Spain to buy ships and arms and ammunition here, it is we who will conquer Cuba, not Spain. It is we who will crush liberty!

To secure victory for Cuba it is necessary for us, in my opinion, to take but a single step; that is, to recognize her belligerency; she will do all the rest. That step the government will doubtless hesitate to take at the present state of the struggle, because as yet the insurgents have neither instituted a government nor established a capital. In the last insurrection they did both, besides maintaining a state of war for ten years. That a state of war exists to-day is virtually admitted by the proclamation of Governor-General Campos, who in addition to the army under his command, consisting of about 60,000 regulars and 40,000 militia, calls for heavy reinforcements, and the Spanish war office has been obliged to order out the first class of reserves. Moreover, a commander-in-chief routed in battle and fleeing, his "rear-guard fighting bravely all the way into Bayamo," to use his own words, connotes nothing less than war.

When the Cuban government is set up, as it soon will be, we shall have equally as good international authority and precedent to recognize a state of war in the island as Spain did for our own Confederate insurgents forty days after the shot on Fort Sumter. We can return to her, in the interests of liberty, the compliment she then paid us in behalf of slavery. The justice will be poetic. With all possible decorum, with a politeness above criticism, with a firmness wholly irresistible, we should assist Spain out of Cuba and out of the hemisphere as effectually as Lincoln and Seward did the French invaders of Mexico in the sixties. Moreover, according to American precedent, neither a state of hostilities nor the setting up of a civil or military organization is positively necessary to entitle a people to belligerent rights; for before either of these conditions were established in 1838, we went so far as to issue a proclamation for "prevention of unlawful interference in the civil war in Canada."

Our record toward Spain is clear. We heartily approved when George Canning invoked the Holy Alliance to prevent her from recovering her American provinces, and in 1825 we refused to guarantee her perpetual possession of Cuba in exchange for commercial concessions to ourselves. Our obligations to her are measured by an easily terminable treaty, which, however, while in force, in no way prevents us from recognizing Cuba's belligerency. Is it difficult for us to decide between free Cuba and tyrant Spain? Why not fling overboard Spain and give Cuba the aid which she needs, and which our treaty with Spain cannot prevent? Which cause is morally right? which is manly? which is American? Clarence King.

[Since the above was written the ferocious policy of the past in Cuba, has been officially revived. A Havana correspondent of the New York Herald says:

"Madrid cable messages of date September 10 are being published in that city. They give the official views of Senor Canovas del Castillo, of Madrid, acting for the government of Spain, concerning the rebellion in this island. His manifesto is a carefully prepared document, and clearly is the government programme under which General Martinez Campos will initiate his cool weather campaign. The part of Cuba affected by the rebellion—the eastern end of the island—will be freed from all rebels and their adherents. It will be war to extermination or surrender to all Cuban rebels, macheteros and the like.

* Abstracts from an able article in The Forum for September, 1895, by Clarence King.

"The military organization will be full and complete. It will be root and branch work this time; no foot will be allowed to remain to create future disturbances. Hereafter Cuba will be for Spain. Spain will enter on the fall campaign with only one object in view—the immediate and absolute subjugation of the island. The portion of the rebels will be death or deportation.

"Amid the many precautionary measures, one will have an instant and appreciable effect on the rebels who need arms, ammunition and supplies. Early in November, when the war vessels are reinforced by the new gunboats, the whole island will be surrounded by two lines of war vessels. One line will cruise in an inner circle and one in an outer circle—practically a huge blockading fleet of some sixty modern war ships.

"It is believed that this arrangement will absolutely preclude the landing of any men or supplies."

The desperate efforts that are being made by Spain to overcome the revolutionists in Cuba is seen in the hurried dispatch of troops to the island. A recent number of La Ilustracion Espanola of Madrid, speaking of the last contingent of 25,000 men sent forward, says: "On their arrival there will be 80,000 Spanish troops in Cuba, to be followed in October or November by 25,000 more, making 105,000 in all. To these forces are to be added the local troops, consisting of 60,000 volunteers, 13,000 cavalry, and 116,000 militia, making a grand total of 294,000."

An interesting article, containing the views of the distinguished Spanish statesman Sr. Pi y Margall, is given in our SUPPLEMENT, No. 1025.]

[FROM THE INDEPENDENT.]

THE FLORIDA INFAMY.

THE Orange Park Normal and Industrial School opened four years ago with twenty-six pupils. The second year it had one hundred and sixteen, representing nine States; the third year, owing to hard times, only one hundred, from six States; the last year, in spite of the calamitous winter, one hundred and six, from five States. The school has gone on doing its work steadily, quietly, and so successfully as to win high commendation from prejudiced and unfriendly sources. Nearly all the white families in the place and vicinity, having children to educate, have patronized it, and have regarded it with increasing favor and confidence. The white people have always gathered in large numbers to witness the public exercises of the school; and never has there been shown a more general, kind and appreciative interest in the school and its work than during the closing exercises of the last year. Such witness for the school, from those who have every chance to know its merits, counts much in its favor. It may be also mentioned that in the Southern Florida Fair, held last winter at Orlando, over thirty prizes, premiums, or honorable mentions were awarded for the work of the school there exhibited. Finally it is the only school for miles around that is conducted with any regularity and efficiency, where children and youth can be educated. The school has a beautiful and healthy location, with excellent buildings, costing in the aggregate over $20,000, and is supported entirely by Northern benevolence, no aid ever having been asked or received from the State. The board and tuition are placed at the lowest possible figures, and many poor and deserving pupils are helped to pay their own way, or are helped along by personal gifts from Northern friends. The school was founded with special reference to the education of colored children and youth, particularly as teachers of their own race; but when many white scholars sought to share in its benefits, as the best and indeed the only school within their reach, they were not turned away. It may here be remarked, however, that white and colored students always occupy different rooms in the dormitories, different rows of seats in the chapel, and different tables in the dining hall.

This school has been made the object of a determined attack. Soon after Mr. W. N. Sheats became State Superintendent of Public Instruction, reports reached the school of his extreme unfriendliness toward it. So far as the writer is aware, he did not visit the school, or personally inspect its character or work; but he was reported as denouncing it in terms not necessary to repeat. In his biennial report he states that "the efforts Northern benevolent associations are making in this State to educate a few of them" (the colored people) "in schools with the whites are exceedingly exasperating to the negro's Southern friends, who," he adds, with apparent inconsistency, "bear the burden of their education." "The truth is," he continues, "the race has too many loving guardians."

To relieve the extreme exasperation of the negro's Southern friends, and the colored race of their superfluous and over-affectionate guardians, the superintendent requested the Legislature to enact a law prohibiting in both public and private schools any but negroes from teaching schools for negroes, excepting in the matter of normal instruction to their teachers in institutes and summer schools; and, also, "as an act of friendship to the race, to shield them from the folly of some of their friends," a law making it "a penal offense to teach whites and negroes in the same schools, in either public, private or benevolent institutions."

A bill embodying both these recommendations was introduced into the Legislature, House 125, and seems to have passed without opposition. The pretense of protecting colored teachers in their right to teach their own race, however, when there were 116 schools in the State, "mostly colored," which last year were not taught at all for want of anybody to teach them, was too transparent; and the injustice of substantially cutting off the colored race in the infancy of its education from white help was too glaring. The first recommendation failed to become a law, but the second issued in the following enactment, as reported in the Daily American, of Jacksonville:

"Be it enacted by the Legislature of the State of Florida:

"Sec. I. It shall be a penal offense for any individual body of inhabitants, corporation, or association, to conduct within this State any school of any grade, public, private or parochial, wherein white persons and negroes shall be instructed or boarded within the same building, or taught in the same class, or at the same time, by the same teacher.

"Sec. II. Any person or persons violating the provisions of Sec. I of this act by patronizing or teaching in such school, shall, upon conviction thereof, be fined in a sum not less than one hundred and fifty dollars, nor more than five hundred dollars, or imprisoned in the county jail for not less than three months, nor more than six months, for every such offense."

Look at the operation of this law, if it is enforced, as it undoubtedly will be, unless the United States courts intervene. Among the pupils of the Orange Park School, last year, were two white children, bright and intelligent, of a father crippled in one hand, who lived a mile and a half away in an old tent, with his wife and several other children. The poverty of the family was extreme, and the tuition of the children was paid and their clothing in part furnished by their teachers and by Northern friends. There was also a white boy, the son of an invalid washerwoman. When asked to send her boy to school, she said: "We," herself and her mother, "we have nothing but what we earn washing; sometimes we get seventy-five cents a week, and sometimes we get nothing." The boy was furnished with a neat suit, his tuition was paid by a kind lady at the North, who is now willing to pay it for another year, and he was put into the school. He is frail, unlikely ever to earn his living by physical labor; and a chance to learn was to him almost as life from the dead. Two other pupils are colored, children of a fisherman, industrious and honest, who gets a precarious living for his family of six children, and houses them in a shanty without a pane of glass. For eight months, from exposure to cold and wet, he was almost completely paralyzed. His children cross Lake Tulula every day in order to reach the school; and so interested are they that they sometimes row their boat over in weather rough enough to cause the teachers some anxiety for their safety.

Now the Sheats law says to these parents and such as these, that if they dare to send their children to this school any more, as they have done, then they shall be fined in a sum which they can no more pay than they can pay the national debt. And if those who have kindly and faithfully taught these children shall venture to teach them any more, as they have done, then this law holds up before them—ladies and gentlemen of culture, refinement and the highest Christian character—as the penalty for such a crime, imprisonment for from three to six months in the county jail, along with the thieves and drunkards, ruffians and harlots, who may there find lodgment. Is such a law fit for the last decade of the nineteenth century? Is it fit for the statute book of any State that calls itself Christian or even civilized? Can this be the thanks which Florida renders to an association that has never asked of it or received from it a single penny, and only craves permission still to spend, as for years it has been spending, thousands of dollars annually in the Christian education of its children—education which the State itself is not prepared to give?

The need of the school at Orange Park, and of others like it, may be inferred from a few facts. The State of Florida supports one school for every forty-five of her white school population; but only one for every one hundred and two of her colored school population. One county supports one school for every thirty-three white children of school age, but only one for every two hundred and sixty colored children of like age. Another county with 1,753 colored school population has only two colored schools, or one to 876 children. The State pays in teachers' salaries for each white child of school age, $4.42 annually; for every colored child of school age, only $1.42, or less than one-third.

The recent apportionment of the State school fund among the several counties, as the Florida Citizen truly says:

"presents some remarkable features. . . . The counties in which the school fund has been increased by the apportionment contain 23 per cent. of the total negro population of the State; those in which it has been decreased contain 77 per cent. Nineteen counties containing more than three fourths of all the negro children in the State are compelled to suffer a reduction in their school fund of $16,364.60, in order that twenty-six counties, containing less than one-fourth of the negro children, may have their funds increased $5,283.60."

The Citizen also remarks that, during the discussion of this measure:

"no attempt was made to conceal the fact that its purpose incidentally, if not primarily, was to deprive those counties having a large negro population of a portion of the school fund, in order that those whose school population is composed chiefly or largely of white children might receive larger benefits."

A system of teachers' examinations and graded certificates came into effec in 1893, which of itself seems able to retire most of the colored teachers in the State, and to close most of the colored schools. State certificates of three kinds are sometimes issued, but so rarely as scarcely to affect the common schools. Three county certificates of third, second, and first grades respectively are issued to those who pass examinations proportionately exacting. The life of a third grade certificate is one year, of a second grade two years, but both are valid only in the county where issued. The third is not renewable, and apparently also the second. Yet almost nine-tenths of the certificates issued in the State last year were of these two grades, and nearly one-half of the lowest grade. The questions asked are such as teachers find it difficult to answer. At the last May examination in Lake county, which has fifty-two white and fifteen colored schools, only twenty-one white and three colored candidates are reported as applying for examination. Out of three applying for first grade certificate, one succeeded and two failed completely; one candidate passed for second grade and seven for third grade. Fifteen failed entirely, leaving only nine teachers, with some few hold-overs, perhaps, to supply sixty-seven schools. The effect of so rigorous a law upon a race that is only thirty years from absolute illiteracy, and yet, with very scanty facilities for normal instruction, is required to supply its own teachers from its own numbers, must be plain to any one. A county school official recently remarked in conversation, that this examination law would probably result in "retiring nearly or quite all the colored teachers in a few years;" and, of course, in closing most of the colored schools. To elevate schools by extinguishing them does not seem to be the best method. When asked what he did for white teachers, the same official replied, frankly: "Well, we have to use some discretion." Such "discretion" as may keep colored schools running, however, is precisely what county boards are cautioned against using. They are exhorted to "be firm;" if some schools "go untaught for a time, this need cause no alarm." Probably not.

The meaning of such facts is too plain to be made any plainer. Whatever else they show, they prove that the colored people of Florida need all the educational help they have, or can get. They show that the Christian people of the North, and especially the friends of the American Missionary Association, cannot afford to let the Orange Park school be sacrificed.

Florida ought to be a progressive State, and in some respects it is. Its population has increased about threefold since the war, largely by immigration from the North. Northern capital and energy have largely built its railroads and erected its magnificent winter resorts; and Northern patronage is largely supporting both. Northern men are developing its resources, and helping on every progressive enterprise. The law of last winter does not represent the best sentiment of the State, any more than some politicians, now at the fore, represent its best people. "Nothing is ever settled till it is settled right;" and this matter will yet be settled right. For both races there is a better future.

"For ever the right comes uppermost,
And ever is justice done."

ST. HELENA AND THE GRAVE OF NAPOLEON FIFTY-NINE YEARS AGO.*

ON the 21st (April, 1836) we sighted the solitary isle of St. Helena, and in a few hours were sailing under the precipitous crags which were towering a thousand feet above us, affording no sign of vegetation, and only presumed to be inhabited upon discovering here and there upon some lofty peak or jutting rock high above us a small but strong tower or fortress, and a single sentinel pacing the rugged walls. Doubling a steep promontory lined with fortifications, the valley of Jamestown burst suddenly upon our sight, a neat village extending up the ravine until hidden from view by its abruptly winding among the mountains. The Alarm House, a pretty country residence, appears upon the high land overlooking the harbor and town surrounded by a grove of cypress and pine. Zigzag roads cut into the solid rock of the mountain sides, and defended by a wall on the outside, lead to the summits and to the rich vales and plantations in the interior of the island.

We anchored very near the shore in the small, exposed bay in front of Jamestown valley, exchanged salutes with the fortress on Ladder Hill, had an interview with our commercial agent, Mr. Carroll, and then prepared to visit the island rendered so important in the eyes of the world by being the resting place for the remains of the ambitious Napoleon.

St. Helena is a strong military post garrisoned by nearly eight hundred king's troops. The present governor is Major-General Middlemore. One wide continuous street runs along the center of the valley, lined with neat dwellings and shops, and others smaller run parallel and at right angles to this. There is very little appearance of indus try or enterprise among the citizens. When the island was under the control of the East India Company, one or more members of every family held a lucrative office in the company's service, and when it was resigned to the crown most of them received a handsome pension for life.

On the 22d, arrangements having been previously made by Mr. Carroll, a party of officers, accompanied by the family of our agent, set off on horseback and in carriages for Napoleon's grave. Our path for two miles lay along the steep and waste side of a mountain. Having reached its summit, the scene is entirely changed. Commodious farm houses, cultivated fields, green forests and rich valleys delight the eye. Herds of cattle, grazing upon the plain of Longwood and in the rich ravines adorned with luxuriant verdure and a rapid brook, abound. St. Helena, it must be said, is not the barren rock generally described, and has not that grim, sepulchral look so frequently ascribed to it by the erring pen of prejudice. As beautiful scenery as the eye ever gazed upon is to be met with at every step, and a more surprising combination of the grand and pleasing in landscape is nowhere to be found on this earth's picturesque surface than exists along the slopes of Sandy Bay.

Following the main road through the grove of cedars and pines around Alarm House, we arrived at a steep path leading to the quiet valley in which repose the ashes of the emperor. Our carriage could go no farther, so we all proceeded on foot. In a few minutes we were leaning on the iron railing surrounding the tomb, and in solemn silence regarding the stone which covers the dust of the ablest soldier this world of ours has yet produced. The tomb is in the plainest possible style. Three or four flat stones, once composing the kitchen hearth in old Longwood, lying even with the ground and surrounded at the distance of a foot by an iron railing—at the foot of the grave a few tulips and geraniums planted by Madam Bertrand, robbed of their leaves and branches by the thousands of visitors from every country under heaven—an aged willow, looking maimed and desolate, yet struggling to throw over the grave of the exile a few green branches (weeping sadly over fallen greatness), a spring of crystal water from the hill side, are all that meet the gaze of the stranger standing in this honored cemetery of a solitary grave.

The tomb is guarded by two invalid soldiers, who invite you to inscribe your name in a book kept in a small shed or sentry box built over the spring, and on presenting written permit from the town major, will admit you within the black, circular wooden fence about the tomb several feet distant, and allow you to take a few twigs from the willow tree. We all availed ourselves freely of such permission, and I for one will ever treas-

* Abstract of an account written by Dr. David Graham Adee, U.S.N., U.S.S. Vincennes, and published in the United Service for September.

ure up this frail memento of dead genius. The spot in which Napoleon is buried is truly beautiful. The vale, narrow and always green, terminates suddenly in an amphitheater formed by the hill at the head of the ravine, a fine residence upon it once occupied by General Bertrand, with hanging gardens on the sloping declivity in front. It is as picturesque a site for a grave as any soldier need care to covet, and to the eye of the sea-tossed sailor as pleasant a spot to live in as any island in the ocean offers, a place well suited for a home and haven to happily anchor in at last.

From the tomb we proceeded to old Longwood, over a cultivated tableland on which were herds of cattle grazing. From this high position we commanded a fine prospect of green valleys, naked rocks, and of the sea dashing against the steep cliffs and iron-bound shore. We alighted at a house of miserable aspect, partly in ruins, and bearing the appearance of what it is now in reality, a badly kept barn or stable. We were ushered through a front room in which stands a billiard table, into the room where the emperor breathed his last. A thrashing machine now occupies a place opposite where formerly stood his bedstead. The walls of this small apartment are so completely defaced and despoiled of everything in the shape of wood, paper, stone, and mortar, which the curious visitor could detach and bear away with him, as little to resemble the bedroom of royalty. The apartment to which his remains were transferred and lay in state is now a stable, and a horse was feeding in a stall on the very spot where once lay the body of Napoleon. In a few years every particle of this house will be carried away and its materials distributed over every part of the civilized world. This building, so mutilated, bore so little semblance to a habitable dwelling for human beings that I could scarcely conceive of its ever having been occupied by the great exile, and was glad to get out of it into the open air again.

A short distance from this barn stands literally a palace, built by the British government at enormous expense expressly for their illustrious prisoner. But he would never consent to live in it, preferring a simple shed to a gaudy, gilded cage.

We next took a long, circuitous ride around the island, over ridge and mountain, and through fertile dells, visiting in our route the borders of Sandy Bay, a part of the island as rich in magnificent and varied scenery as any part of Europe, and winding up at Plantation House, the summer residence of the governor. The grounds of this seat are delightfully laid out in winding walks, graded terraces, and silver streams, and we enjoyed a charming promenade through groves of trees from nearly every clime, transplanted to this congenial spot. We culled bright flowers, plucked fresh figs, and could not resist the impulse to rob an orchard of some blushing peaches. Then we returned to Jamestown by Ladder Hill, highly pleased with our jaunt, and without encountering rain or any accident. We dined and spent the evening at our consul's, and, after many toasts and bumpers at the table, the evening was enlivened and ended by both music and the dance.

THE GLASGOW DISTRICT SUBWAY.*

By A. M. Stewart.

A want long felt in Glasgow has been some means of rapid transit between the center of the city and the outlying residential districts. In 1887 a bill was promoted in Parliament for the purpose of obtaining powers to construct a subway or underground passenger railway, connecting Partick and the northwest districts with the center of the city. Powers were refused; the principal reason for the refusal being the novel system of working which was proposed. The principal aim of the method referred to was the reduction of first cost—a very important matter with a new and independent company. The idea was to construct a tunnel of sufficient width to accommodate a train running on either of two double lines of rail the centers of which were three inches apart. Trains going in one direction to use one line and those going in the opposite direction to use the other, passing one another at the stations which would have island platforms. The stations to be equidistant, in order that passing trains would arrive at them almost simultaneously. The motive power to be cable or electricity.

The system mentioned having been abandoned, in the following year, 1888, powers were applied for to construct a subway, consisting of two endless tunnels, connecting the districts to the south, as well as those to the west and northwest, with the center of the city, and were again refused; the principal reason for this refusal was that, where it was intended to pass under the River Clyde, the proposed level of the tunnels was not at a sufficient depth to admit of future deepening of the river to any great extent. In the year 1889, the Glasgow Harbor Tunnel Company obtained powers to construct tunnels under the harbor at Finnieston. A precedent having been thus established—so far as the river was concerned—powers were again applied for in the year 1890, to construct a subway, differing somewhat in detail from that proposed in 1888, and were granted.

General Description.—The total length of the subway is six and one-half miles. There are fifteen stations, the average distance between them being less than one-half mile. Each of the two tunnels which form the subway is eleven feet in diameter, and they are constructed between three feet and six feet apart. The stations are twenty-eight feet wide and one hundred and fifty feet long. Each station has an island platform, ten feet wide, to which access is obtained at one end by means of stairs and short passages, six feet to eight feet in width, with a total rise of twenty to thirty feet to the street above. There is to be an endless traction cable in each tunnel, and both cables are to be driven from one power station. The gage of the railway is to be three feet nine inches. It is intended to run trains consisting of two cars, each car to be forty-one feet long over all, and to seat forty-two passengers. The cars will be very roomy and will be capable of carrying about double this number if necessary.

As soon as powers were obtained, the survey for the working plans was commenced. A double series of lines was run round the route to be followed, and from these the details on the surface were surveyed for a distance of two hundred feet to three hundred feet on each side of the intended center line. This survey having been plotted to a scale of 1-500, the plan of the subway was drawn and the route was sectioned. Where the subway passes through private property, the property was bought outright, as it was considered more economical to adopt this course than to pay high rates for way leave. For the greater part of its length, however, the subway follows the line of streets, under which it has a free right of way. The line being roughly circular in plan, the total amount of curvature is considerable. The sharpest curves are of six hundred and sixty feet radius, an easy curve on a cable railway. The ruling gradients are very slight; but advantage has been taken of the practicability of steep gradients in passing under the River Clyde, where a vertical curve with a maximum gradient of one in eighteen is introduced. Each station is approached from both sides by slight rising gradients. The formation in the southern and low-lying districts

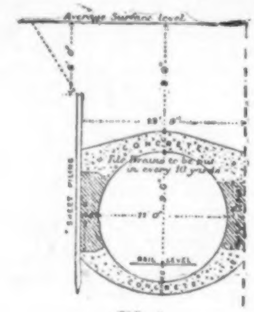


FIG. 1.

through which the subway passes consists of alluvial deposits—running sand, clay and mud. In the northern and northwestern districts the lay of the land is high and there is a rock formation. In the soft formation, the "cut and cover" method of construction was employed wherever practicable, but elsewhere tunneling by the "shield" system was employed. In the rock formation the tunnels were formed by the ordinary method of blasting.

Construction by "Cut and Cover."—Where the "cut and cover" system was adopted, the tunnels were built according to the cross section shown in Fig. 1, and the method of construction was as follows:

Two rows of four inch sheet piling, twenty-seven feet six inches apart, were driven to the formation level, the piling being carried to the surface of all streets traversed. A trench was cut between these to the level of the intrados of the double concrete arch. At the level of the arch, and seven feet apart, spaces 2×2×1 ft. were cut through the piling. The bottom of the trench having been carefully shaped with the aid of profiles, the double arch was laid, care being taken to pack the spaces cut through the piling. Two coats of asphalt, each three-fourths inch thick, having been poured over the arch, the trench was filled up and the surface of the ground was restored. The arch was set in lengths of about fifteen feet. The excavation underneath the arches was proceeded with in one tunnel at a time. As the first tunnel advanced, one-half of the double invert was laid, and one side wall and one-half of the center wall were built—the arch being supported meanwhile on one side by the dumpling of the other tunnel, and on the other side by the grip obtained on the piling by means of the spaces cut through and filled with concrete. As the second tunnel advanced, the other half of the invert was put in and the other side wall and half of the center wall were built—the arch, in this case, being supported on the one side by that half of the center wall already built and on the other side by the grip on the piling. When passing through vacant ground, this method was varied—the trench being carried in the first instance down between the piles, which were ranced across, to the formation level of the invert. The invert was then put in, the side walls were built, and the arches were turned on centering in the open. At intervals of twenty-five yards, manholes, communicating between one tunnel and the other, were constructed. They are three feet wide, five feet high, and are arched at the top. Every ten yards, four

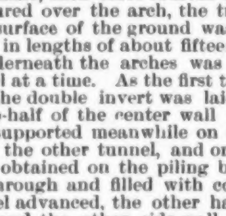


Fig. 2.

inch tile drains were built into the center wall, and water collecting in the hollow between the arches drains through these into the tunnels. In the center portion of the arches the concrete consists of four parts of broken stones or bricks to one part of Portland cement, with sand as required. In the haunches it is five to one and in the invert six to one.

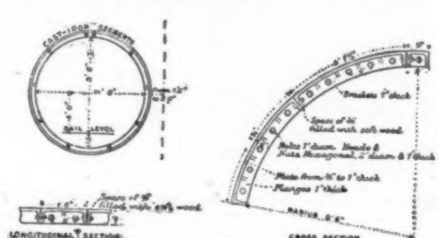
For about one-fourth mile the material was so soft at the level of the invert that, on an attempt being made to build it in the usual manner, the concrete sank into and mixed with the mud. To dry the material, by driving back the water, air pressure was successfully employed. There was a large escape of air at the sides of the arch, but the requisite pressure of two pounds to three pounds on a square inch was maintained without difficulty. The tunnels were constructed by "cut and cover" partially under several buildings. These were supported during construction in the following manner: Heavy spaced piles were driven outside, and close to the walls of the buildings. These supported a timber staging which was passed in below the walls, and on which the latter rested while the operations were proceeded with underneath them.

The tunnels having been formed, the walls were underpinned from the arch with brick. The timber was then removed, any of the piles which passed through the arch being cut out.

Tunneling in Soft Material.—On those portions of the subway where the material passed through was soft and the surface could not be opened the tunnels were lined with cast iron built in segments. The cross section is shown in Fig. 2.

Figs. 3 and 3a show the details of the segments, each of which is about 4×1 ft. 6 in., the key piece being 9×1 ft. 6 in. These were found to be of a convenient size and weight to be handled, and the soft wood made an excellent and easily fitted joint. Where not quite watertight, the joints were wedged up with oak wedges. The iron lining was built up inside a shield which consisted of a cylinder of sheet iron strongly braced in front. It was fitted with a steel cutting edge and to the bracing were fitted eight hydraulic rams. These rams pressed on the completed lining, and by their means the shield was forced forward as the tunnel advanced. Any one of the rams could be worked independently of the others, so that the direction of the shield might be altered as required. They were worked by means of two hand pumps.*

The tunnels were constructed under sufficient air

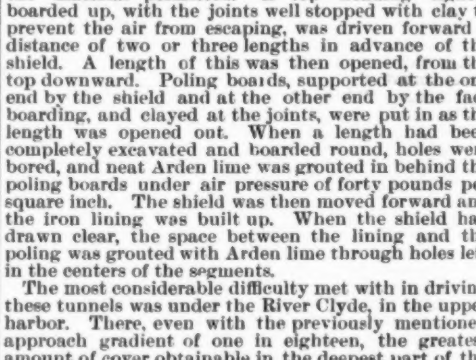


FIGS. 3 AND 4

pressure to drive back the water. This varied between seven pounds and thirty pounds on a square inch. A brick in cement stopping closed the entrance to each tunnel where work was being carried on under compressed air; and into this were built an airlock for the passage of men and material, a nine inch pipe to admit the compressed air, a six inch pipe, with a valve on each end, for the passage of long rails for the temporary way, a small water supply pipe, a pipe for supplying the high pressure air to the grouting machine, a small pipe through which any water that collected in the tunnels was forced out, and a tube containing wires for signaling by electricity from one side to the other.

The lining was built in lengths consisting of between one ring and three rings of segments, as the nature of the material permitted. A top heading tightly boarded up, with the joints well stopped with clay to prevent the air from escaping, was driven forward a distance of two or three lengths in advance of the shield. A length of this was then opened, from the top downward. Poling boards, supported at the one end by the shield and at the other end by the face boarding, and clayed at the joints, were put in as the length was opened out. When a length had been completely excavated and boarded round, holes were bored, and neat Arden lime was grouted in behind the poling boards under air pressure of forty pounds per square inch. The shield was then moved forward and the iron lining was built up. When the shield had drawn clear, the space between the lining and the poling was grouted with Arden lime through holes left in the centers of the segments.

The most considerable difficulty met with in driving these tunnels was under the River Clyde, in the upper harbor. There, even with the previously mentioned approach gradient of one in eighteen, the greatest amount of cover obtainable in the deepest part of the river, near the north quay wall, was thirteen feet. This cover consisted for the most part of silt. The tunnels were driven southward from the station in St. Enoch Square, and everything went well until the



Figs. 5 and 6.

leading tunnel had just passed the quay wall, when the pressure of air inside the tunnel proved to be too great for the strength of the cover and a hole was forced through into the bed of the river. Through this hole the water gained access to and flooded the tunnel. It was filled up from above with good stiff clay obtained at another part of the work, air pressure was again applied, the water was forced out, and tunneling was recommenced. Operations had only proceeded a few feet when another similar burst took place. This and several others which followed were treated in a similar manner. The bursts at last became so numerous that the contractor gave up the contract. The company took over the plant, and, on the assurance of the engineers that the design, provided due precautions were taken, was practicable, made a special agreement with another contractor to complete the work. As soon as possible a fresh start was made, and the new contractor, by carefully regulating the air pressure according to the state of the tide, and

* Read at a meeting of the Association of Glasgow Students of the Institution, January 28, 1895.

* The shields here used were the well known Beach hydraulic shields, an American invention, now generally used by engineers for this class of work.

placing thin sheet iron under the poling boards in the top of the working for the purpose of distributing the pressure over them as evenly as possible, drove the leading tunnel without another burst to the other side of the river. The second tunnel was also successfully driven, only one burst occurring in it. Careful soundings of the river were regularly taken during the progress of the works, and any deepening of the bed, caused by the scour of the river, was filled up with clay.

Tunneling in Rock.—The section of the tunnels in rock is shown in Fig. 4. The arch is lined with two to four rings and the side walls with two rings of brick in cement. A concrete lining of equal thickness was substituted for the brick where the tunnels were driven through rock of sufficiently good quality to be broken for concrete. The concrete was gaged, five parts of broken stones to one part of cement, with sand as required.

Numerous difficulties, chiefly caused by water, were encountered in the construction of the tunnels. In one place a large quantity of water lying in an old quarry was tapped, and a section of the tunnels about one-fourth mile in length was completely flooded. In another place, the strata dipped in such a manner that the upper half of the tunnels penetrated the subsoil. A thick layer of sludge which had at one time formed the bed of a stream lay over the rock. When the face of the leading tunnel entered the bed of sludge, the weight of the traffic in the street above pressed the sludge out into the tunnel, and considerable subsidence resulted. On this being observed, the faces of the tunnels were bricked up, and others to meet these were driven forward under air pressure and lined with iron segments.

A seam of old coal waste, which underlies the Hillhead and Partick districts, was met with, and substantial structures of brickwork had to be built on both sides of the tunnels to relieve the arches from thrust. This seam of coal crops out on the banks of the Kelvin to the north of Hillhead, and when the river was high it flooded the waste and greatly impeded the progress of the work. The greater portion of the tunnels was through rock under streets carrying a large amount of traffic, and they had to be worked from shafts sunk in side streets. These shafts were sunk about one-fourth mile apart.

Stations.—The stations are constructed either in tunnel, in covered way, or in the open between retaining walls. The section of those stations which are located in tunnel are lined with brick in cement, the thickness in the arch being between four and seven rings and in the side walls between two and four rings of brick, according to the nature of the material in which they are constructed. The section of stations in covered way is shown in Fig. 5. They have concrete arches two feet six inches thick at the crown and concrete inverts two feet thick at the center. The side walls are three feet thick at the springing of the arch, and are built of brick in cement. The section of stations between retaining walls is shown in Fig. 6. The walls are six feet thick, faced with an average thickness of two feet of brick in cement bonded into a backing of concrete.

Drainage.—Wherever a natural fall to the river Clyde can be obtained, drains are being constructed to carry off the water that gains access to the tunnels. Where a natural fall cannot be obtained, the tunnels will be kept dry by pumping.

Power Station.—The trains are to be drawn by two steel cables, one and one-half inch in diameter, one in each tunnel. Both cables are to be driven from one power station. The power required is estimated at 1,000 horse power to 1,400 horse power. Two main driving engines are being provided, each of which will be capable of doing all the work; but they are to be so arranged that during times of extra pressure both may be brought into operation. The engines are of the single cylinder non-condensing type. The cylinders are forty-two inches in diameter, with a six foot stroke. It is intended to drive the cables at fifteen miles per hour; but the engines are being so constructed that this may be increased to sixteen and one-half miles an hour.

The engineers of the work are Messrs. Simpson and Wilson, of Glasgow, to whose assistants resident on the work the author is indebted for much of the information contained in this account. The arrangement of the power plant has been intrusted to Mr. D. H. Morton, Assoc. M. Inst. C. E., Glasgow.

ACTION OF THE ELECTRIC CURRENT UPON ALUMINUM WIRE.

AMONG the singular properties that differentiate aluminum from other metals, we may mention its very feeble volatility at elevated temperatures. Although aluminum melts at a temperature intermediate between that of the fusion point of zinc and silver, say at about 625°, this metal may be raised to a white-red heat without perceptibly evaporating and without undergoing a profound oxidation. At this temperature, the majority of the metals less fusible than aluminum became strongly oxidized or partially volatilized.

If an aluminum wire be traversed by an electric current sufficiently intense to heat it beyond its melting point, we find, contrary to all expectation, that it may be raised to a dazzling white and kept in this state, contrary to what occurs with other metals submitted to the same test, which, when their point of fusion is reached, suddenly break, each extremity of the breakage presenting the form of a small metallic globule produced by the contraction due to the superficial tension of the liquefied metal.

Aluminum behaves very differently. If the wire has been first stretched between the two supports that lead the current, it incurves strongly, but may remain for quite a long time in a state of complete incandescence until the moment at which the breakage takes place, which is generally in proximity to the points of attachment of the wire.

Aluminum wire is evidently formed of a liquid fillet that oscillates at the least puff of wind and is kept in the air by the cohesion of its molecules, and probably also owing to the formation of a very thin pellicle of alumina, which plays the role of an infusible protective sheath around the metal in fusion. This layer is in any event of very slight thickness, for a microscopic examination reveals no very manifest traces of oxidation. The aspect of the metal is rather that of a bar imperfectly melted, in which is produced a phenomenon of disengagement of dissolved gas, analogous to what occurs with silver. The surface of it is rugose, although brilliant, and covered with small well defined craters, multiple erosions, and, here and there, blackish spots with a graphitoid aspect. Besides, the wire has become fragile, as if the metal had undergone a sort of crystallization. In the vacuum produced by an ordinary air pump, aluminum presents the same peculiarity of cohesion in the fluid state, but seems to preserve more homogeneousness than in the air. The same is the case if the experiment be made in carbonic anhydride.

The following table summarizes a few experiments made in the air with filaments of aluminum of different lengths and diameters. These figures are merely approximate, for it would be impossible to deduce therefrom a precise proportionality between the intensity of the current and the power of resistance of the wire at the temperature of bright red, such intensity varying between wide limits according to the length of the wire interposed between the supports, which have a very great disturbing influence upon the measurements.

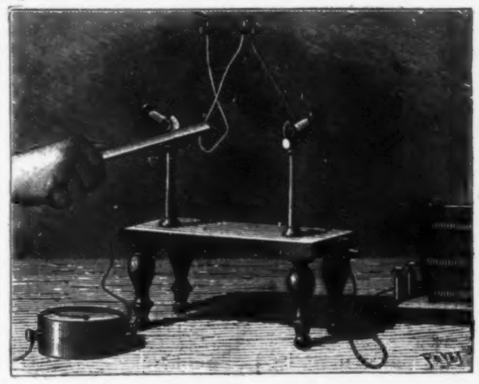


FIG. 1.—ACTION OF A MAGNET UPON A CURRENT, DEMONSTRATED BY MEANS OF AN INCANDESCENT ALUMINUM WIRE.

It is easy to see that aluminum rapidly cedes to the supports a part of the heat disengaged, and that with wires of decreasing lengths it will require increasing current intensities to bring them to the same temperature. (See table.)

It will be seen, for example, that a filament of aluminum, 0·5 mm. in diameter and 10 cm. in length, is capable of supporting an absolutely extraordinary intensity of current, say about 31 amperes, when it is at a bright red. The resistance of the wire increases in very strong proportions, since, with the same wire, the difference of potential at the extremities, almost null at the beginning, so long as the current does not reach a value sufficient to heat the metal in an appreciable manner, rapidly augments and reaches a value of 5 volts, when the wire has become of a dazzling white. The resistance of the aluminum wire, brought to the square millimeter of section and to the meter of length, would be about 0·4 ohm, while when cold it is but 0·03 ohm.

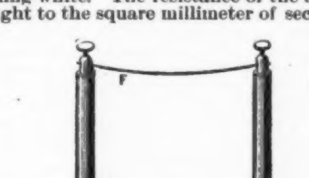


FIG. 2.—ANOTHER FORM OF THE SAME EXPERIMENT.

Length of Wire.	Diameter.	Intensity.	Difference of Potential.
m.	mm.	amperes.	volts.
0·033	0·17	7	4
0·033	0·40	22	2
0·033	0·33	17	2
0·100	0·50	31	5

Results of the experiments.

This experiment, which is easily performed, consists in confining the extremities of the wire between two clips and gradually increasing the intensity of the electric current up to the normal regime reached when the metal is really luminous, that is to say, when it has the appearance of the filament of an incandescent lamp. Too abrupt a putting in short circuit with all the current intensity that the wire can support would risk the ultimate breakage of it.

The length of the aluminum wire, morever, may much exceed the above indicated figures, although the fragility increases with the length of it. We have, nevertheless, succeeded in reddening wires of from 30 to 40 centimeters in length, and, under such circumstances, it has been permitted us to give a striking, though transitory, form to the action exerted by a magnet upon a circuit traversed by a current (Fig. 1).

The wire, of a length of from 25 to 30 centimeters and of a diameter of 0·3 mm., is fixed by its extremities to the supports that lead the current, so that one may give the lower part of it the form of a nearly closed loop placed in a vertical plane. The loop, having been rendered incandescent by the passage of the current, is extremely sensitive to the approach of a rectilinear magnet of medium strength, and, according to the direction of the current, or the pole of the magnet placed in its presence, is violently repelled or attracted. As a general thing, and it is here that the experiment becomes most instructive, the repulsion changes into an abrupt torsion of the loop upon itself, which naturally tends to present to the pole of the magnet the face in which the direction of the current is such that an attraction may occur. The experiment is of short duration, since, at this instant, the abrupt rotation puts in contact the median parts, and, consequently, in short circuit, the upper extremities of the filament, which break under the action of too intense a current.*—Charles Margot.

The very interesting experiment described above, and that we have more than once repeated since Mr. Margot had the kindness to communicate it to us, certainly owes its realization to the easy oxidation of aluminum. In fact, even at the ordinary temperature, this metal becomes covered with an adhesive layer of alumina, which protects it against other modifications, and which explains several of its peculiarities.

Such layer pre-existing, the experiment in a vacuum or in a neutral gas would not be conclusive unless the metal were freed from it in the very medium in which the experiment was prepared, for example, by washing it with potassa or a little dilute hydrochloric acid. The thickness of the layer, moreover, increases somewhat at high temperatures. In fact, we obtain a good electric contact with an aluminum wire that has not been heated, while after after such operation the contact becomes difficult and irregular.

We know that it is superficial oxidation that makes aluminum so difficult to solder, and all the processes of soldering this metal are founded upon the cleaning of the surface and the protection of it against the oxygen of the air. Working it with tools in the lathe, which is generally done with a petroleum distillate, also utilizes the protection against oxidation, which would be followed by a very rapid wear of the tools.

It is also such superficial oxidation that prevented Woehler from agglomerating the granules that he was the first to isolate, leaving to Sainte-Claire Deville the invention of the first metallurgy of aluminum. We know, moreover, that a liquid cylinder, whose length slightly exceeds the triple of the diameter, is unstable, and that the least distortion becomes very rapidly emphasized under the action of capillary forces, and causes the breakage of the cylinder in an extremely short time. We recall, even, that upon such property is founded a very curious instrument—the Bell hydraulic microphone. It results from all this that aluminum wire heated to a temperature much above its melting point owes its stability only to a sort of solid sheath that incloses it on every side and prevents it from reassembling in drops. The feeble density of the metal, moreover, assures the mechanical resistance of the chain that it forms between its two supports.

The first application that Mr. Margot tried to make of the phenomenon discovered by him is very interesting and most demonstrative, and deserves to be introduced into lecture courses wherever there is a current of thirty amperes at one's disposal.

The lightness of aluminum wire and its liquid state render it sensitive to the slightest action. For example, by a proper arrangement of the experiment, there may be given to the wire a very marked pendulum motion through the rotation of a rectilinear magnet placed at 50 centimeters or 1 meter above or beneath (Fig. 2). With a horseshoe magnet its position is deviated or it is twisted at will.

We can even go farther. Experiments with magnets are as a general thing quite easy, while the forces that are exerted between the currents are more difficult to put in evidence. With an aluminum wire, nothing is easier. If by means of a vertical copper wire, we lead the current to an aluminum one suspended from the first, the latter will be observed to recede from its support as soon as it attains a high temperature, while it suddenly falls when the current is interrupted. The experiments that can be made with parallel wires are so evident that it is not necessary to dwell upon the subject.

The very bright light of the wire heated by a current renders all these experiments visible to a large roomful of spectators. This light that the wire exhibits at a high temperature is doubtless further intensified by a phosphorescence of the alumina. Such phosphorescence would even tend to make it thought that the wire, from its aspect solely, had a higher temperature than was really the case. However, we hasten to add that there can be no doubt as to its liquid state when it reaches a dazzling whiteness.—La Nature.

THE SPECTRUM OF CARBON FROM THE ELECTRIC FURNACE.

IN a recent communication to the Académie des Sciences, M. Deslandres stated that M. Moissan recently pointed out that the carbons which he uses for his electric furnace are purified by the passage through them of the large currents employed. As it is very difficult to purify carbon by the chemical way, M. Deslandres emphasizes the importance and interest of this property of the electric furnace, especially to spectroscopists, who often use pure carbon in qualitative analysis. It was on this account that M. Deslandres paid special attention to the statement of M. Moissan, and carried out an investigation to verify its

* These experiments succeed as well, and even better, with very fine platinum wires raised to incandescence, and which, although less sensitive to magnetic action, by reason of their greater density, show, nevertheless, in a very elegant form, the effects of attraction and repulsion due to the approach of a magnet. However, it has not been possible for us, with platinum, to clearly obtain the curious return of the circuit so readily observed with aluminum.

correctness. M. Moissan placed at M. Deslandres' disposal two carbon electrodes, a positive and a negative, 20 cm. long and 5 cm. thick, which he had made use of in some electric furnace experiments. M. Deslandres took from each electrode small pieces of carbon at distances of 15, 10, 5 and 1 cm. from the arc. He found that the pieces which were taken from the electrode at some distance from the arc showed the ordinary impurities of carbon, namely, alkaline metals, together with copper, iron and silicium. When, however, he came to examine the pieces which had been taken close up to the arc, the bands denoting impurity finally disappeared, with the exception of the calcium bands, which, although very much reduced, always remain visible, a fact which M. Deslandres attributes to the lime wall of the furnace, which is probably partly volatilized when large currents are used. M. Deslandres attributes this purification of carbon to a purely physical cause, the impurities being much more volatile than carbon, and being therefore vaporized before it. The purest carbon was obtained from the mushrooms which form on the negative, and with one of these mushrooms M. Deslandres obtained a spectrum which contains fewer impurity bands than any of the spectra hitherto published.

ORGANIC CHEMISTRY.*

THE following is the text of the speeches delivered on the occasion by Prof. Dixon, Sir H. E. Roscoe, M P., Mr. L. Mond, and others:

Prof. Dixon said he had received a number of letters apologizing for inability to attend, including one from Mr. A. G. Vernon Harcourt, President of the Chemical Society. One and all of the writers wished prosperity to the new laboratory that would bear the honored name of Schorlemmer. Among the senders of messages from abroad were Profs. Beilstein, of St. Petersburg, Emil Fischer, of Berlin, L. Meyer, of Tubingen (whom they had just lost), Victor Meyer, of Heidelberg, L. Claisen, of Aachen, and an old friend of Schorlemmer's, Dr. Caro, of Mannheim, from whose letter he read an extract. Prof. Dixon, continuing, said he desired to express, on behalf of his colleagues and himself, their admiration of the noble simplicity of Schorlemmer's life and character. He believed that Schorlemmer was absolutely unguided in any matter, great or small, by any consideration of his own advantage or his own ambition. He wore the gifts of genius with a singular quietness and equanimity, and he used them nobly and well. He was a standing example to both staff and students of unselfish devotion to that which he considered to be his duty as professor. He was ever ready to give his time freely to those who came to him for help and advice. No man could more truly be said to have lived for the sake of his work—work which included scientific investigation of the highest kind; and of that high work Owens College, they were proud to remember, was from the beginning and remained to the end, the center and the inspiration. They who lamented him might be sure of this, that there was no tribute which would have been more welcome to him, that there was no memorial which could more fittingly perpetuate his name, than one which, while it expressed their admiration for his life and work, would provide for the continuance and development of that work within the walls of the college where he himself lived and labored.

Sir H. E. Roscoe, M.P., who was cheered on rising, said it was a painful duty, as well as a great pleasure, for him to take the chair, on that occasion—a painful duty because of the thought that the man whose memory they were called together to honor might still have been among them and working for the progress of that science for which alone he lived; a pleasure because of the thought that they were offering a tribute to steady, persevering work, and unselfish devotion to the cause of scientific advancement. In a brief sketch of Schorlemmer's life, Sir Henry said he came of a poor burgher's family at Darmstadt, a little town the birthplace of a larger number of eminent chemists than any other city could boast. In early years he showed his ability, and entered the university of his native land. After he (Sir H. Roscoe) had completed his own regular course of studies in Germany and was about to return to England, William Dittmar, who was then Bunsen's assistant, expressed the wish to come to England with him, and on his (Sir Henry's) appointment to the chair of chemistry in that college in 1857, Dittmar accompanied him to England and worked as his private assistant, Frederick Guthrie, who had occupied the position under Frankland, continuing to teach the fifteen students who then formed the sum total of those working in the Owens College laboratory. Soon Guthrie left for the Mauritius, and at the beginning of the session of 1859 Dittmar reigned in his stead. He (Sir Henry) then needed another private assistant, and in those days no competent young Englishman was to be found—now they might be reckoned by scores—and Dittmar advised him to send for a young friend of his who had studied for a year in Giessen. So Schorlemmer came to him, and remained his faithful and intimate friend for thirty-four years.

He at once found out the kind of man with whom he had to deal. He remembered well the energy and ability with which Schorlemmer attacked the problem of distilling hydrofluoric acid, both under increased and diminished pressure, and how some of the strong acid injured his hand, forming a wound which did not heal for months. Two years later Dittmar resigned, and Schorlemmer was placed in the position of the sole assistant and demonstrator to a somewhat increased number of students. In that new position his powers as a laboratory teacher soon made themselves manifest, and much of the subsequent success of their laboratory was due to his tact and knowledge, and to the genuine enthusiasm which he displayed in imparting that knowledge to others. He (Sir H. Roscoe) remembered as though it were only yesterday the first beginning of the original work which had made his name eminent among the chemists of the time. Mr. John Barrow, of Gorton, who was then occupied with the manufacture of benzene by the distillation of cannel coal—for the supply from the gasworks was then not equal to the demand—sent him (Sir H. Roscoe) some of the light oils which he obtained in his process. They were of no commercial value, and had not been investigated. He submitted these oils to Schorlemmer, knowing their investigation was a hard nut to crack, but knowing also that Schorlemmer was the man to crack it. The examination of those oils was the beginning of Schorlemmer's scientific fortune. That was not the occasion to discuss Schorlemmer's scientific work, for was it not written in every manual of organic chemistry throughout the world, and had it not been described fully in his own "History of the Rise and Development of Organic Chemistry," recently edited by his pupil Prof. Smithells? He would only say that Schorlemmer's investigations on the constitution of the hydrocarbons marked an era in modern organic chemistry; and while his work in itself had a purely scientific value, it, like much other work of a similar character, enabled other men to build up an industrial structure, the value of which was measured by millions of pounds sterling, and gave now employment to thousands of men. For it was not too much to say that without Schorlemmer's discoveries the knowledge of the constitution of the carbon compounds which we now possess, as typified by Kekulé's theory, could not have been arrived at. And so Schorlemmer worked away as the demonstrator at Owens College, assisted, as numbers grew larger, by the pupils whom they trained, until 1874, when he became the first and only professor of organic chemistry in the kingdom. Turning to the literary talent of the late Prof. Schorlemmer, Sir H. Roscoe said his power of work was simply prodigious, and his knowledge of chemical literature deep as well as broad. He much valued and made use of their admirable medical library. He, of course, lived and died a poor man, though, had he chosen, he might have amassed a large fortune. His distinction was, however, none the less on that account, but as some would think, all the more. Schorlemmer added another name to the list of distinguished foreigners who had found a home in these islands. Never again could it be said that England failed to recognize and appreciate the value of the services of those who sought her shores. The names of Herschel, of Von Hofmann, of Max Muller, and lastly, of Schorlemmer, indicated that we were not slow to give honor to those who were once strangers in the land, but who had made themselves members of our national family. In conclusion, Sir Henry reminded those assembled that they had in the director of the new laboratory—Prof. Perkin—a man able and determined to carry on, in still higher measure, the work which his predecessor inaugurated. They might have good hopes that ere long the time would come when the leaders in chemical industry would appreciate the necessity of a thorough scientific training, as had long been the case in Germany; and that as Giessen was, under Liebig, the means of raising the standard of chemical education throughout the Fatherland, so the chemical department of Owens College might, under the direction of Profs. Dixon and Perkin, with their admirable coadjutors, be pointed out as the institution in England which had done the same for this great empire.

Mr. Ludwig Mond said the opening of the first laboratory solely devoted to the study of organic chemistry at the only university in England which can boast of a professor of that science, marks a distinct step forward in the development of science in this country.

In dedicating this laboratory to the memory of Schorlemmer, to whom science and this university owe so much, we must all regret that it was not vouchsafed to him to have the use of such a special laboratory at his disposal. Nevertheless the spirit which he infused into his work, his pupils and his books, will be the most valuable endowment which this new building inherits, and will manifest itself in the work of all those who have the good fortune to work here, if they approach their task with the same single mindedness and love of truth that marked the late Prof. Schorlemmer.

His work has been singularly fruitful in clearing up and putting on a sound basis the modern theory of organic chemistry, called by him so appropriately the chemistry of the carbon compounds.

For it was Schorlemmer who provided the fundamental proof of the equal value of the four valencies of carbon, the very corner stone of the great edifice by which we have obtained an insight into the simple laws upon which the immense variety of organic compounds is built up. And the value of the work not only extends to the chemistry of carbon, for the more we succeed in penetrating into the constitution of the more complex compounds of other elements, the more we are forced to apply the same laws which we owe to the study of organic chemistry to explain their constitution.

Now you may ask—and very properly ask—if organic chemistry is so closely related to inorganic chemistry—if it only treats of the compounds of one element out of the large and daily increasing number of elements from which our universe is built up, why I consider it a great step in advance to have a special laboratory and special professors appointed for the study of the chemistry of this one element. The answer is this; the subject matter of chemistry has become so vast a domain and is increasing at such an immense rate that for any one desiring to further contribute to it, it has become a necessity, after mastering the main facts of the science, to give his attention specially to the details of one or other part of it.

While it is true that carbon is only one out of many elements, it possesses such very special properties that the multitude of its compounds probably outnumbers those of all the rest of the elements together, and it has the unique interest that all the innumerable substances that are found in plants and animals, which build up their tissues and by their constant changes produce the phenomenon we call life, are all compounds of carbon. It is for this reason that we call the chemistry of these compounds organic chemistry, and it is very natural that this branch of our science should be nearer to our hearts than any other branch.

But there is another and stronger reason for having special laboratories of organic chemistry. The methods of investigation and our way of mentally analyzing these compounds differ considerably from those applied to inorganic chemistry. In the latter, if we have ascertained by an accurate analysis of a pure substance its percentage composition, this, together, with the determination of a few simple physical properties, is usually sufficient to give us a perfect insight into its chemical composition and behavior. The laboratory methods required for this study are simple, and most of them are well known, so that they can be acquired by sufficient experience. In organic compounds the matter is very different. The percentage composition and the physical properties tell us very little of their chemical individuality and behavior. Many substances of exactly the same percentage composition possess widely different qualities which are not explained by their physical properties. We must find out how these compounds, many of which are very complex, are built up. We have to unravel the structure of these substances to attain our end, which, in chemical investigation, always means to give an explanation of all the various properties of a substance through its chemical constitution.

To ascertain its structure we have to break the organic substance down by degrees, to take it gradually to pieces; and even that is not enough; but to make sure of the actual arrangement of these pieces in the substance, we have to put them together again, we have to rebuild the substance from its proximate constituents, and only after having accomplished this can we consider that we know its constitution.

The methods employed in this work are entirely different from those of ordinary analysis. They are very manifold. The investigator has to make his own choice which of them to apply in any individual case, and wherever he breaks new ground and undertakes the study of a new series of compounds, he has to discover and work out new methods before he can achieve success.

It is evident that a student aiming at qualifying himself for such high class work should enjoy special facilities, and should, after having gone through a regular course of analytical chemistry, have a chance of prosecuting special organic work in a laboratory fitted specially for it, and where he is undisturbed by the army of beginners who throng an analytical laboratory; and here I may point out that in my opinion the reason why this country has not advanced in organic chemistry as fast as other countries—the reason why Von Hofmann's prediction in his report on the exhibition of 1862 that "England will be unquestionably at no distant date the greatest color-producing country in the world," has not been fulfilled, but that Germany has almost entirely taken this industry out of her hands—has been that so few English students of chemistry have devoted sufficient time to the prosecution of their studies.

It is evident from what I have said—and it is the experience of other countries—that in order to attain the necessary experience and certainty in carrying out original investigation in organic chemistry, four to five years of close study and attention, under the leadership of a competent professor, are a necessity, and for carrying on successfully the manufacture of artificial colors it is indispensable that the chemist should be able to carry out independent original research, because new colors have to be discovered and manufactured, and the processes for their production have to be constantly improved in order to compete successfully with rival manufacturers. It was not, indeed, the workman, not the foreman, as so many people in this country still believed; it was the leading mind, which directed the manufactory, upon whom the success of an industrial enterprise depended—his thorough grasp of scientific principles, and his trained habits of scientific thought.

But it may be asked: "Is it not, after all, too late now for opening a special laboratory for organic chemistry? Is there yet enough to be learned about carbon compounds and of sufficient importance for science in general to repay the intricate and tedious work involved? Is there any hope to match the brilliant results already achieved? Can anything beat the galaxy of brilliant colors which the last forty years have drawn from coal tar? Has not the time arrived when we should set our face against the supremacy which the carbon compounds have held during this period, and give our attention to the study of other elements which, in the opinion of many in this country, have been only too much neglected? Should we not above all devote our energy to those phenomena common to all elements which we now comprise under the term of physical chemistry or molecular physics?"

I agree that it is desirable to cultivate physical chemistry and inorganic chemistry much more than has been done during the period under review, and I am very glad that the great supremacy which organic chemistry has enjoyed, more particularly in Germany, the home of chemistry, is now being contested by other and equally important branches of our science; but great, and very great, as has been the progress of organic chemistry, it has greater and more important problems still to solve; and in this country, which has given birth to so many of the most important steps in advance of that science, it has not received that amount of general attention which it has deserved in the past, and which it still deserves in the future. I therefore specially and heartily welcome the opening of the first laboratory exclusively devoted to it in England.

Professor Schorlemmer, in his excellent and most suggestive little work "On the Rise and Development of Organic Chemistry" (the careful study and repeated perusal of which I cannot too strongly recommend to the student), after giving a lucid review of the steps by which the great edifice of that science has been built up, gives in his concluding remarks a perspective of the problem still to be solved—wide enough for the most expansive imagination of any searcher after truth.

I cannot do better than read to you a few sentences from this remarkable book:

"When Ettling, in 1838, found that salicin yielded on oxidation the essential oil of Spiræa ulmaria, Liebig wrote to Wohler: 'This is a remarkable fact; we shall yet make sugar and quinine and uric acid.' In the same year Wohler and he published their classical research on uric acid, and wrote: 'The philosophy of chemistry will from this work draw the conclusion that the production of all organic matters in our laboratories, in so far as they do not belong any more to the organism, must be regarded not only probable but as certain. Sugar, salicin, and morphine will be made artificially."

If to-day we still cannot make morphine, quinine and similar bodies artificially, the time is near at hand.

* Opening of the Schorlemmer Organic Laboratory, in the Owens College, Victoria University, Manchester, Eng.—May 3, 1895.

If we cannot make quinine, we have already found a partial substitute in antipyrine, and its introduction into therapeutics has lowered the price of quinine considerably.

Another important problem is the synthesis of the ingredients of our daily food, such as sugar, gum and starch. These bodies are nearly related to each other, for we can convert the two latter into different kinds of sugar, and sugars again into gums. That the synthesis of sugar is imminent has already been stated.

But it is quite different with those important parts of our food which have been called the albuminous bodies. All that we know of them is their percentage composition, and that they contain the carbon atoms linked together partly as in the aliphatic compounds and partly as in the aromatic bodies.

Kekulé, in discussing the scientific aims and achievements of chemistry, wrote: "The hypothesis of chemical valency further leads us to the supposition that also a relatively large number of single molecules may, through polyvalent atoms, combine to net-like, and, if we may say so, spongelike masses, in order thus to produce those molecular groups which resist diffusion, and which, according to Graham, are called colloids. The same hypothesis leads us, in a most natural manner, to the view already pronounced by our eminent colleague, Pflüger, that such accumulation of molecules may extend yet further, and thus build up the formative elements of living organism. Of these mass molecules, we may perhaps further suppose that through the constant change of position of polyvalent atoms, they will show a constant change in the connected individual molecules, so that the whole—of course with development of electricity—is in a sort of living state; particularly so as, through similar displacements, adjacent molecules may be drawn into the circle of combination and newly formed ones expelled.

"The idea thus brought forward may perhaps be expressed by saying that if ever chemist should succeed in obtaining albuminoid bodies artificially, it will be in the state of living protoplasm, perhaps in the form of those structureless beings which Hachell calls the Monera.

"All attempts hitherto made for the purpose of producing living matter artificially have failed. The enigma of life can only be solved by the synthesis of an albuminous compound."

Professor Emil Fischer, of Berlin, to whose genius and indefatigable work we owe the greatest advance as yet made in the synthesis of organic bodies suitable for human food, as it was he who succeeded, by a long series of most brilliant scientific investigations, to build up a whole series of sugars from their constituents—Professor Fischer, in a beautiful lecture delivered not long ago in Berlin, also expresses himself full of confidence that the time will arrive when we may attack successfully even the problem of the constitution and synthesis of the albuminoids, and may thus approach the problem of the origin of life.

Surely with such a prospect before us as the ultimate result of the pursuit of organic chemistry, no amount of work, no amount of thought, no amount of time and trouble devoted to this study, will be too much if it is well employed in leading successfully to the great end in view, although the goal may not be reached for generations to come.

I need not dwell, in this town of Manchester, so famous as a center of chemical and other industries, and in this county of Lancaster, which I believe is the most densely populated part of the world, and consequently depends more than any other for its food supply, i. e., for its very existence from day to day, upon the products of the field of countries far away—I need not dwell here upon the immense economic importance of the solution of these problems, which have so far been pursued by men of science for the pure sake of knowledge, from the love of truth for its own sake, which is and no doubt will always remain the greatest impetus to the greatest minds. Our progress is measured by the increase of our knowledge, which alone enhances our power over the forces of nature, and enables us to turn them to the use of man. A new principle once acquired will soon be found to be applied to the requirements of our daily life. Any advance in pure science is very soon followed by advances in our industries. To cite an example, the immense development in the practical application of electricity which we have all witnessed within very recent years, we owe far more to Faraday's scientific work than to all the numberless inventors who have followed up his discoveries and turned them to practical use. Certainly nothing could be further from my mind than to detract from the merit of the inventor who devotes his energies and his knowledge to utilize the advances of science for improving the conditions of our daily existence. I belong myself to this class, and the best part of my life has been spent in this work.

Scientific discoveries do rarely supply us with all the knowledge required for their practical application. The inventor has frequently to supplement it by other scientific discoveries before he succeeds in his task. But the work of the scientist has to be made first, and the scientific principles have to be elaborated and to be clearly understood before any real important progress in our industries can be achieved.

I therefore appeal to the students assembled here to give their whole attention to the progress of science, for its own sake, without looking forward to an immediate practical result. This is sure to come sooner or later. Let us hope that this new laboratory which we are opening to-day will soon be the scene of active and successful work in the great cause of science, and will have its full share in the scientific triumphs of the future. The mantle of Schorlemmer has descended upon Professor Perkin, who, by the excellent and most important work he has already done, has given the most abundant proof of his worthiness to wear it, and of his ability to take a leading part in the further development of organic chemistry. But the success and renown of the new laboratory will rest upon you his pupils, upon the zeal, the earnestness, and the devotion with which you will prosecute your work.

Why Birds Remain Perched.—The reason given that birds do not fall off their perch is because they cannot open the foot when the leg is bent. Thus a hen while walking will close its toes as it raises the foot and open them as it touches the ground.

PHYSICAL THEORY OF THE PERCEPTION OF COLORS.

By Georges Darzens.

In order to explain the perception of colors, Young, and subsequently Helmholtz, admitted that each fiber of the optic nerve which enters into a cone of the retina is composed of three fibrils, one of which is strongly excitable by the red and little by the green and the violet; the second strongly excitable by the green and little by the red and the violet; and lastly, the third is strongly excited by the violet and little by the red and the green.

This hypothesis accounts for the existence of three elementary colors; it equally explains a certain number of other facts, such as some peculiarities observed in dyschromatopsies, the phenomena of saturated colors, etc. But it is unable to explain many other facts not less important. Why should light having a wave length of μ 0·620 strongly excite one of these fibers and have scarcely any effect upon the two others?

Here is a new theory of luminous perceptions which seems to me to agree better with the progress of physical optics and of physiology.

A luminous ray, after having traversed the different strata of the retina, impinges normally upon the pigmentary layer of this membrane; there it is reflected, and interferes with the incident ray. Hence we must have there in front of the pigmentary layer, and consequently in the actual thickness of the retina, a system of stationary waves distant by $\frac{\lambda}{2}$, as in the experiments of O. Wiener, or in those of Lippmann on the photography of colors. It is further probable that these stationary waves can exist only in a feeble thickness on account of the absorption by the medium which constitutes the retina.

Let us remark, in passing, that this specular function of the pigmentary layer exists in an unquestionable manner in the ox, where it constitutes the "carpet." These stationary waves excite the nervous terminations of the optic nerve. These terminations are of two orders, the rods and the cones.

The rods being constituted by cylindric fibrils, respectively parallel, we can conceive that the stationary waves will excite them all, whatever may be their position—that is, whatever may be the λ of the incident light. Hence we conclude that the rods give to the brain the general notion of light without enabling us to judge of its color. We know that the brain always conveys its excitements to the circumference, whatever may be the place where the nerve has been excited.

The cones, on the contrary, being formed of fibers, parallel but unequal in length, will be excited differently according to the λ; they will enable the brain to take account of the color.

These two conclusions are fully verified by experiment.

It is known that we do not perceive all the colors well except by the central part of the retina (the yellow spot). Now it is there where the cones are found, the rods being turned toward the equator of the retina, which gives merely the sensation of light without the notion of color.

On the other hand, nocturnal animals which do not distinguish colors have no cones, while in birds which feed on colored insects the retina is rich in cones.

Finally, if this theory is correct, whenever the pigmentary layer disappears, whether by old age or disease, there must result a parallel enfeebling of sight (a chromatopsy). This is apparently confirmed by experience.

This new theory can be brought to harmonize with the hypothesis of Young and Helmholtz. We need merely admit that the fibrils of the cones are divided into three groups proceeding to three different centers of perception. Still more, it explains why the wave length which strongly excites one of these groups of fibrils must excite the other two groups feebly. It explains that curious arrangement of the retina when the excitable elements (cones and rods) are found placed in the deepest stratum, turned, so to speak, away from the side of the pigmentary layer which has hitherto appeared inexplicable.

It is remarkable to note that the procedure employed by the eye, in taking account of the wave length of a ray of light, is quite comparable with the procedures hitherto employed by physicists.

To me this theory appears satisfactory to reason, since it reduces the perception of colors to the appreciation of a wave length which is a magnitude of an order comparable to the dimensions of the anatomical elements of the retina. It further seems to me to throw a clear light on the explanation of a number of the peculiarities of the eye.

To cite merely a single instance in the study of the achromatism of the eye, we must no longer consider the retina as a simple screen like those of our laboratories, but a screen which perceives the different colors in different zones.—Comptes Rendus, cxxi, p. 133.

PHOTOGRAPHIC NEWSPAPER ILLUSTRATIONS.*

By Thomas Wakeman Lane.

"As bad as a newspaper cut" does not mean as much as it did in those not very distant days when newspaper illustration had not reached the position which it at present holds, thanks to photography. I do not mean to say that there are not many poor cuts still printed in the newspapers, but that the wide-awake modern daily newspaper, which keeps abreast of the times in other respects, prints every day in its columns pictures which, when we consider the conditions under which they are made, are as marvelous as many other modern institutions which cause vastly more public wonder and admiration. It is, however, perhaps, only a fresh instance of the truth of the old proverb, "familiarity breeds contempt."

To none of the arts, sciences or industries has photography been a better servant than to journalism; though as photography is in this case only the means and not the end, its services are likely to be overlooked by those who do not see behind the scenes.

Newspaper photography has peculiar features of its own—and they are all "instantaneous." It has but little to recommend it as photography for its own sake, because it is not photography for its own sake, because it is not photography practiced as a science, a recreation or a study, but purely as a mode of "getting there." The newspaper photographer is not likely to keep stores of his old negatives and prints for their own sake, and probably could not if he would, because he does not have time to wash them for posterity's sake.

The ordinary careful amateur who visits a landscape scene a half a dozen times before he catches the right light effect, and spends half an hour in developing the plate, which he washes in running water all day and then waits for a bright, clear day to make prints from it for his friends would be likely to have some of his traditions upset on watching the newspaper photographer at work, and be inclined to consider the latter as rather a reckless young camera fiend. With the latter the proper light is just light enough to make an exposure by. He wants a negative as good as possible, of course, but he wants it right away, because it is a daily paper he is working for, and not a quarterly review. As for prints, he only makes one from each negative at the most, and its only use is as a basis for another negative, which, from the ordinary photographic point of view, is worse than the first, with clear glass and intense black right up against each other, and no half tones, because the newspaper press despises half tones and would print them as nasty black smudges, simply spoiling so much clean paper.

The qualities which a newspaper illustration must have in order to be printable on rapid presses and look well on the sort of paper newspapers are compelled to use limit the choice of processes practically to line etching on zinc and certain mechanical processes which imitate its effects. With the history of this process it is not necessary to deal, and with the small details of manipulation I will not attempt to enlighten or weary this audience. In fact, I should have no right to do so, as such information on the technical side of zinc etching as I may be able to lay before you has not been gained by practice of the art, but by continued rubbing up against it in the line of duty.

We will suppose word has just been received by the city editor from police headquarters that a boiler in a Kensington mill has exploded and caused a serious loss of life and property. Of course, reporters are sent promptly, and a few years ago that would have been sufficient, but now the illustrator is expected to be "on the spot" with the reporters and only a little behind the firemen and the police. It may be a man with a portfolio and a pencil or a man with a hand camera or may be both. We will let the sketch artist take care of himself and follow the man with the camera while he takes snap shots at that pile of wreckage or at that big hole in the wall of the nearest building through which part of the big flywheel has been hurled. The exposures made, our camera man starts for his dark room to see what he has got. He develops his plates, fixes them and selects two or three of the best, washes the hypo off the surface of the films, squeegees pieces of wetted bromide paper on them, exposes them to the electric light for a moment, develops and fixes them, rinses the hypo from them, and they are done. Very sloppy photography, some of us might say, and so it would be if negatives and prints were intended to last more than half an hour.

If there is not much hurry, the bromide print may be tacked up behind a small electric fan and dried. This process would only take a few minutes, but a quicker mode is to squeegee the still wet print on a piece of glass. In this shape it is handed over to the process photographer, who fastens it by means of drawing tacks against his copying board, turns on the big electric arc light and makes a considerably enlarged copy by the wet collodion process. Inside of five minutes from the time he pulls the slide from the plate holder he has his negative ready to make a print from, thanks to the heat from a gas stove and the aforesaid electric fan. Or if the case is one of rush, as late at night, he puts the wet negative in the printing frame, lays a thin sheet of mica upon its tender film and on the mica a sheet of plain salted and silvered paper. Under the powerfully active rays of the arc light two minutes will suffice to print a plain image. This print need not be fixed, as the draughtsman will not give it time to fade. It is hastily mounted on cheap cardboard, dried over the gas stove and turned over to the artist, who has laid aside the sketches which he had to fall back upon in case the camera man had failed.

It is now an easy task for the trained draughtsman to go over the photograph with pen and India ink and translate the picture into lines, which are the only things the rapid newspaper press of our day recognizes. The leisurely printed week lies and monthlies can have their half tones on copper and photogravure frontispieces, as well as the one sort of plates which the newspaper is obliged to make its only resort.

When the artist has finished his drawing over the silver print then comes more photography. The photo-drawing goes back to the operator, who pours over it a solution of bichloride of mercury, which has the apparent effect of dissolving away the photograph and leaving only the India ink lines. As a matter of fact, it bleaches the photographic image white, so that it is not distinguishable from the white paper on which it was made.

The drawing now takes its turn in front of the big camera and the arc light, and from it another wet plate negative is made, reduced to the exact size that the illustration is to be when finished. When the developer is applied an image comes up which we would call decidedly hard. In fact, the harder it is the better the process photographer likes it and the more popular he will be with the etcher.

Plain development is not enough, so our operator, after getting all the density he can by developing and redeveloping without fogging the transparent portions which represent the black lines, fixes and bleaches the negative white, usually with a bichloride of mercury or a bromide of copper solution and blackens it with a solution of ammonium sulphite or

* Read before the Photographic Society of Philadelphia.—From the American Journal of Photography.

nitrate of silver. If the negative takes on the appearance of a stencil plate, i. e., looking like a piece of sheet iron with the lines of the picture cut through it, the intensification has been a success.

The next step in the process is the stripping or "turning" of the negative. If the block were made from the negative as it is at this stage, the picture would appear reversed—tintype style—so a reversed negative becomes a necessity. In the now almost lost art of wood engraving this obstacle was overcome by drawing the picture on the wood reversed. In modern process work the same thing can be accomplished, and frequently is, by using a right angled prism or a mirror to produce the reversed negative; but the zinc etcher is much given to "stripping," as it is usual in newspaper offices to etch several pictures at one operation and on the same sheet of zinc. He probably has, besides our disaster illustration, a portrait or two, a fashion plate and may be one or more pieces to be used in the advertising columns. In fact, one has to be almost as careful about the pictures he looks at in the newspapers nowadays as of the wonderful stories he starts to read without looking how they wind up or he may find the fair lady whose beauty he is admiring is not the heroine of the latest big scandal, but only Mrs. Muggins, of Squedunk, who has recovered her good looks by the casual wearing of Dr. Sparks' magnetic belt.

But this is a digression. To return to our subject, the negatives are flowed with a solution of rubber in benzole, followed by a heavy coating of collodion to thicken and strengthen the delicate film, and are then placed in a dilue solution of acetic acid, which soon dissolves the layer of albumen which holds the collodion film to the glass. This allows the films containing the picture to be lifted from their original supports and laid the other side up on a piece of thick plate glass. The films are then squeegeed tight to their new support and dried, and the negative is handed over to the etcher.

This active young man has by this time a sheet of zinc nicely polished with willow charcoal, coated with a solution of ammonium bichromate and albumen in water, and dried. More photography, you will observe.

The negative is placed in the printing frame, a ponderous affair built of oak and put together with strong iron bolts. The glass which supports the negative is an inch thick, and the back of the frame is studded with fifteen or twenty set screws which are necessary to press the stiff sheet of zinc into close contact with the negative. A grain of dust between those two pieces of glass means a disaster, for besides the expense of replacing the glass, there will probably be no picture in to-morrow's paper, as such a mishap is sure to occur when it is too late to remedy it.

Assuming that this is not the occasion of such ill luck, however, the frame goes under that big arc light and in the course of about ten minutes there appears a very faint image on coated zinc plate. The etcher takes what looks to us like a very queer means of strengthening it. He seizes a big roller covered with a greasy, black ink, and rolls it all over that shiny plate, and covers the whole surface, picture and all, with the ink. The plate, which is now blacker than your hat, is put into a tray of water, to be developed. The magician, for such he seems, takes in his hand a tuft of cotton and begins gently to "swirl" it around in the water over the blackened plate. Whatever the cotton touches there begins to come out of the blackness a picture, almost, if not quite, as marvelously as did the image on your own first negative. Soon all the ink is gone except that which sticks to the lines impressed in the bichromated film by the light striking through the transparent portion of the negative, and we have a beautiful image of black on a background of polished metal. This could go into the acid bath, and the ink would resist long enough to allow a shallow etching to be made, but to permit of the eating out of the meta which is in the way of the picture these delicate lines must be strengthened, and over them is dusted powdered dragon's blood, a resinous substance, which by the heating of the plate melts and unites with the ink, and effectually protects the metal which is to form the lines. After a short period in the acid bath, the plate is taken out and again powdered, the melted resin running down on the sides of the lines and thus protecting them against undermining by the action of the acid. This is repeated as many times as may be necessary to get proper depth for the etching, and might be continued until holes had been etched through the plate. In practice, however, a machine called a "router" is used to deepen the depressions in the metal where the blank spaces of the cut are to be. The "router" is a drill-like tool, rotated at very high speed, and mounted on a radial arm, which can be moved in all directions, and quickly cuts the metal to any desired depth. After this all that remains to be done is to trim the edges of the bit of zinc carrying the picture and nail it on a base of such thickness that the finished block shall be of the exact height of the type beside which it will stand in the newspaper page.

How long has all this taken? In an English book on modern methods of illustrating, a reference is made to newspaper work such as I have described, and the somewhat surprising statement is made that "three or four hours will suffice for the etching, and thus, in cases of pressure, a block can be ready for the printing press in five or six hours." Such a rate may do in cases "of pressure," as that term is understood in England, but newspaper etching plants in America which cannot take a cabinet photograph and turn out a portrait block ready for the printers in an hour have a first-rate title to the term "slow."

In at least one establishment of which I have knowledge this is considered an easy allowance for a hurried portrait, including the copying of the original photograph, making a plain silver print, drawing, making the line negative, printing on the zinc, etching, routing, mounting and taking a proof.

I have here a proof impression of a cut showing the scene of a quintuple murder in the outskirts of Camden. The two men who went on this assignment caught the ferryboat leaving for Camden at 11 P. M., struck a bargain with a hackman on the other side, drove three miles behind a horse which threatened to die once or twice before he got to Cramer's Hill, sketched the premises by gaslight, caught the twelve o'clock boat back to Philadelphia, and delivered the completed drawing to the photographer and etcher early enough for them to produce the finished block in plenty of time to be used in the paper at two o'clock, the usual hour of going to press.

The result is a faithful likeness to this extent, that the owner of the house started in surprise when his eyes fell upon it in the paper next morning before he knew what had happened to make his property famous.

The specimens here shown were not made in such a hurry, as the occasion did not demand it, although the time spent on the careful drawing of this excellent portrait probably did not exceed half an hour.

After the cut is finished there are still other processes which affect the result as it appears to the newspaper reader. It is bound to lose some of its brilliancy and cleanness of line in the stereotyping process, though with the best of workmen in this department the loss may not be serious, while still appreciable.

The pressman also has a large responsibility as to the final appearance of the newspaper illustration, and no part of the paper will so soon show the effect of too much or too little ink, too light or too heavy impression, etc., as the illustrations.

If the illustrations do not "show up" well when the publisher and the editor-in-chief, the severest of all critics in most cases, look over their papers in the morning, someone is going to hear about it. Then the pressman and the stereotyper are pretty sure "those fellows upstairs don't know how to make cuts," while the draughtsman, the photographer and the etcher can't be convinced that the "fellow in the cellar" knows how to print them.

I will leave it for you to say whether they do not all deserve more credit than they usually get.

APPARATUS FOR WASHING NEGATIVES.

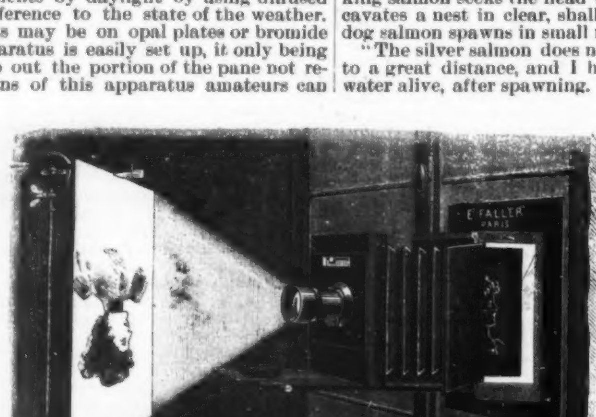
THIS light and convenient negative washer is specially intended for use by tourists, as with it negatives can

APPARATUS FOR WASHING NEGATIVES.

be thoroughly and expeditiously washed with a small amount of water. It consists of a standard which holds the jet. To the metal pipe is connected a rubber tube which has two bulbs attached to it. The lower end of the tube is placed in the vessel of water, and on squeezing the lower bulb a fine continuous spray of water is projected on the plate. Similar contrivances are in use in the United States for shampooing at home. For our engraving we are indebted to La Photographie Francaise.

APPARATUS FOR MAKING ENLARGEMENTS BY DAYLIGHT.

THE apparatus shown in the annexed engraving is made by E. Faller, Paris, and is specially arranged to produce enlargements by daylight by using diffused light without reference to the state of the weather. The enlargements may be on opal plates or bromide paper. The apparatus is easily set up, it only being necessary to stop out the portion of the pane not required. By means of this apparatus amateurs can



APPARATUS FOR ENLARGING PHOTOGRAPHS.

make enlargements which would otherwise have to be sent to a professional enlarger.—La Photographie Francaise.

LIFE HISTORY OF THE SALMON.

THE life history of the salmon is very interesting, and is graphically told by Dr. Tarleton H. Bean, ichthyologist of the United States Fish Commission, in the "Report on the Salmon Fisheries of Alaska" (1892), published by the United States government. He says:

"The marine life of the Alaskan salmon is unknown from the time the young, in their newly acquired silvery dress, leave the fresh water nursery to become salt water sailors, until they have ended their cruise, obtained their liberty and come ashore, when, as in the case of so many other salt water sailors, their serious trouble begins. Salmon remain in fresh water until the second or third spring of their existence, and, not having a bountiful supply of food, they grow very slowly, and seldom exceed eight inches in length when they start seaward. In the ocean they feed on the capelin, the herring, and a small needle-shaped fish called the lant. They are reputed also to consume large quantities of pink fleshed crustaceans, and to derive from them their attractive color. Opposed to this theory is the fact that many other sea fishes whose food consists almost entirely of such crustaceans are never pink fleshed.

"There is no such fishery at sea for any of the Pacific salmons as there is in the Baltic for the Atlantic salmon. After the great schools have broken up and the scattered fish come into the bays, some of the species can be caught on a herring-baited hook by trolling. The king and silver salmon are captured in this way.

"As a rule, the fish remain at sea until they are about ready to deposit their eggs, and then approach the coast in great masses. A few young males accompany the schools every year, and may or may not return to sea without entering the rivers. The adult fish come up from the sea at a certain time of the year, the king salmon arriving first in the month of May in southern Alaska [March or April in Columbia River] and about June 6 in Norton Sound. The dog salmon and the red salmon appear in June, the humpbacks in July, and the silver salmon in August. The length of their stay at the river mouths before ascending and the rate of ascent to the spawning grounds depend upon the urgency of the breeding condition. In the long rivers the king salmon travels from twenty to forty miles a day; this species and the red salmon are reported to be the greatest travelers. The silver and dog salmon, however, are recorded by Dr. Dall as traversing the Yukon at least one thousand miles. As a rule, they frequent the smaller streams, and the little humpback runs into mere rivulets.

"From the time the salmon enters fresh water it begins to deteriorate in flesh and undergoes remarkable changes in form and color. Arriving as a shapely fish, clad in shining silvery scales, and with its flesh pink or red, it plays around for a little while between salt water and fresh, and then begins its long fast and its wearisome journey. No food is taken, and there are shoals, rapids and sometimes cataracts to surmount; but the salmon falters not, nor can it be prevented from accomplishing its mission by anything but death or an impassable barrier. Its body soon becomes thin and lacerated, and its fins are worn to shreds by contact with the sharp rocks. In the males a great hump is developed on the back behind the head, and the jaws are lengthened and distorted so that the mouth cannot be closed.

The fish are soon attacked by the salmon fungus, and progress from bad to worse until they become unsightly. In the meantime the body colors will have varied from dark gray in the humpback, with the lower parts milky white, to a brilliant vermilion in the red salmon, contrasting beautifully with the rich olive green of its head. The excessive mortality of the salmon during the ascent of the streams and on the breeding grounds has led to the belief that none of the spawning fish leave the fresh water alive. There is a substantial basis for this view in the long rivers, and it is doubtless true that a journey of five hundred miles or more is followed by the death of all the salmon concerned in it.

"The nest is a very simple affair, or it may be wanting. The humpback struggles and crowds up a few rods from the sea, and deposits its eggs between crevices in the bowlders covering the bottom, or sometimes they are strewn in thin layers over a large area in shallow water without covering of any kind. The king salmon seeks the head waters of streams, and excavates a nest in clear, shallow, gravelly rapids. The dog salmon spawns in small rivers and creeks.

"The silver salmon does not usually ascend streams to a great distance, and I have seen it return to salt water alive, after spawning. The nest is made among gravel and stones, from which all dirt and slime have been removed. Both sexes take part in the building operation, and the male especially guards the nest. Turner states that the silver salmon use their snouts in collecting material for the nests, and he has seen them with the nose worn off completely.

"The red salmon spawns around the shores of deep, cool lakes, and in their tributaries, preferring waters whose highest temperature rarely exceeds 55°. The nest is a shallow, circular pile of stones, some of which are about as large as a man's hand, and some of them smaller. The eggs are placed in crevices between the stones.

"The enemies of the salmon are numerous. Small fish, called sculpins, or miller's thumbs, swarm in the

nests, and eat large quantities of the eggs. Trout devour great numbers of eggs and young salmon. Gulls, terns, loons and other birds gorge themselves with the tender fry. When the young approach the sea they must run a cruel gauntlet of flounders, sculpins and trout; and in the ocean a larger and greedier horde confronts them. There the adults are attacked by sharks, seals and sea lions. Before they have fairly entered the rivers huge nets are hauling them to the shore almost every minute of the day, during six days in a week. When they return to their spawning grounds, bears are waiting to snatch them from the water and devour them alive. The salmon, it appears, would have been better off had it never been born in fresh water."

The king salmon's average weight is over twenty pounds, and individuals weighing 100 pounds or more are recorded. The color of the flesh is paler than other varieties, but its flavor is finer. For spawning it ascends the rivers to the head waters until it finds suitable gravelly bottom in clear water. No food is taken in fresh water. Only those fish that ascend the streams short distances return to the ocean after spawning. The dog salmon is the least important of all salmon to Americans, but is very valuable to the Indians. Its quality depreciates rapidly in fresh water, so much so that D. F. Bradford says that after being in fresh water twenty-four hours, the fish turn black and unfit for food. The silver salmon is considered excellent in Puget Sound, where it reaches thirty pounds in weight; but it is a fall running fish and seldom ascends the fresh streams any great distance.

The humpbacked salmon is small, weighing only about five pounds, with ten as the maximum. It has very small scales and in breeding season is recognized by its distorted jaws and enormous hump. It is recorded by Chas. Hirsch that in July, 1886, he saw this fish in Karluk River, Alaska, in such enormous quantities that it was impossible to pull a boat across the stream. In the season of 1891 not over 100 specimens of this salmon were caught in the same river in an entire season! In other streams it is still plentiful; and it is one of the most palatable of all the Alaska salmon. The red salmon of Alaska is the blueback of the Columbia, its southern limit. It is next to the smallest of the Pacific salmon, and one of the most important to the canneries. It goes to the sources of the rivers to spawn, the season being from April to August. The steelhead is the species sold in the East as the Kennebec salmon before the Atlantic salmon come in from the sea. It reaches thirty pounds in weight, and is found from Monterey, Cal., to Bristol Bay, Alaska. Its spawning habits are little known, but it is called a winter spawner.

HOW THE SALMON ARE TAKEN.

For catching salmon during the running season, gill nets, traps and seines are employed, the greatest catches in Alaska waters being made by haul seines which sweep the estuaries of the small rivers. "One net follows another in such rapid succession as to cover all approaches to fresh water, and the movement of the salmon into the rivers," says Mr. McDonald, United States commissioner, "is as effectually arrested as if permanent barriers were maintained across the entire width of the stream. Gill nets may be used with the same results by stretching them from bank to bank." On the lower Columbia river these devices, as well as those mentioned in the Dominion government's regulations for taking the fish, are used, and in addition, on the upper Columbia, as Mr. F. A. Seufert tells us, at The Dalles, "salmon are caught almost exclusively in fish wheels. Such a wheel is constructed like a large river steamer wheel, and is from thirty to forty feet in diameter. It has nine arms in each flange. Each three arms are covered with wire so as to form three dips to the wheel. The current running from eight to thirty miles per hour, the wheels make from four to eight turns per minute, catching from one fish to thirty tons daily according to the run of fish and the stage of water. The Dalles is the highest point in the river for fishing in any considerable amount."

THE CATS OF SIAM.

We present herewith illustrations of the cats of Siam which are now exhibited in the Jardin des Plantes, Paris. These cats belong to a pure race widely different from that of our domestic cat. Their body is longer and is leaner than is that of the domestic animal. Their coat is a uniform gray, sometimes a little tawny, and is darker on the legs, ears and tail. The eyes are blue, with black pupils. The cats shown in the illustrations are in the laboratory of M. Milne-Edwards and in the monkey house. Probably a dozen persons in Paris also have specimens of this fine breed of cats. The Siamese cats are more prolific than are those of the north, but succumb far more easily to the rigors of the climate, many dying of consumption. In the family of Siamese cats at the Jardin des Plantes reigns Kiki, a grand male cat that suggests by the general lines of his figure the tiger and the panther. He also carries himself like the larger members of the cat family and possesses their well known suppleness. When he arrived at the laboratory he was very violent. The female cats are, on the contrary, far less fierce. The cats spend a large part of the day huddled up together. There is good comradeship among the cats and the young kittens receive care from all the members of the Siamese cat family. The animals shown in the engraving come from different parties, three having been given by M. Waldeck-Rousseau and another by Mme. Paul Bert. The cat descending

SIAMESE CATS

the bust of the late Maurice, the regretted orang-outang of the Jardin d'Acclimatation as sketched by the artist, is regarded by her family. For our engravings and the foregoing particulars we are indebted to L'Illustration.

THE AIMS OF ANTHROPOLOGY.*

By DANIEL G. BRINTON.

A MODERN philosopher has advanced the maxim that what is first in thought is last in expression; illustrating it by the rules of grammar, which are present even in unwritten languages, whose speakers have no idea of syntax or parts of speech.†

It may be that this is the reason why man, who has ever been the most important creature to himself in existence, has never seriously and to the best of his abilities made a study of his own nature, its wants and its weaknesses, and how best he could amend the one and satisfy the other.

The branch of human learning which undertakes to do this is one of the newest of the sciences; in fact, it has scarcely yet gained admission as a science at all, and is rather looked upon as a dilettante occupation, suited to persons of elegant leisure and retired old gentlemen, and without any very direct or visible practical applications or concern with the daily affairs of life.

It is with the intention of correcting this prevalent impression that I address you to-day. My endeavor will be to point out both the immediate and remote aims of the science of anthropology, and to illustrate by some examples the bearings they have, or surely soon will have, on the thoughts and acts of civilized communities and intelligent individuals.

It is well at the outset to say that I use the term anthropology in the sense in which it has been adopted by this association, that is, to include the study of the whole of man, his psychical as well as his physical nature, and the products of all his activities, whether in the past or in the present. By some writers, especially on the Continent of Europe, the term anthropology is restricted to what we call physical anthropology or somatology, a limitation of the generic term which we cannot but deplore. Others again, and some of worthy note, would exclude from it the realm of history, confining it, in time, to the research of prehistoric epochs, and in extent to the investigation of savage nations.

I cannot too positively protest against such opinions. Thus "cabined, cribbed, confined," it could never soar to that lofty eminence whence it could survey the whole course of the life of the species, note the development of its inborn tendencies, and mark the lines along which it has been moving since the first syllables of recorded time; for this, and nothing less than this, is the bold ambition toward which aspires this crowning bough of the tree of human knowledge.

You will readily understand from this the magnitude of the material which anthropology includes within its domain. First, it investigates the physical life of man in all its stages and in every direction. While he is still folded in the womb, it watches his embryonic progress through those lower forms, which seem the reminiscences of far-off stages of the evolution of the species, until the child is born into the world, endowed with the heritage transmitted from innumerable ancestors and already rich in personal experiences from its prenatal life. These combined decide the individual's race and strain, and potently incline, if they do not absolutely coerce, his tastes and ambitions, his fears and hopes, his failure or success.

On the differences thus brought about, and later nourished by the environment, biology, as applied to the human species, is based; and on them as expressed in aggregates, ethnography, the separation of the species into its sub-species and smaller groups, is founded. It has been observed that numerous and persistent although often slight differences arose in remote times, independently, on each of the great continental areas, sufficient to characterize with accuracy these sub-species. We, therefore, give to such the terms "races" or "varieties" of man.

All these are the physical traits of man. They are studied by the anatomist, the embryologist, the physician; and the closest attention to them is indispensable, if we would attain a correct understanding of the creature man and his position in the chain of organic life.

But there is another vast field of study wholly apart from this, and even more fruitful in revelations. It illustrates man's mental or psychical nature, his passions and instincts, his emotions and thoughts, his powers of ratiocination, volition, and expression. These are preserved and displayed subjectively in his governments and religions, his laws and his languages, his words, and his writings; and, objectively, in his manufactures and structures, in the environment which he himself creates—in other words, in all that whi h we call the arts, be they "hooked to some useful end" or designed to give pleasure only.

It is not sufficient to study these as we find them in the present. We should learn little by such a procedure. What we are especially seeking is to discover their laws of growth, and this can only be done by tracing these outward expressions of the inward faculties step by step back to their incipiency. This leads us inevitably to that branch of learning which is known as archæology, "the study of ancient things," and more and more to that part of archæology called prehistoric, for that concerns itself with the most ancient; and the most ancient is the simplest, and the simplest is the most transparent, and, therefore, the most instructive.

Prehistoric archæology is a new science. I can remember when neither its name nor its methods were known to the most learned anthropologists. But it has already taught us by incontrovertible arguments a wonderful truth, a truth opposing and reducing to naught many teachings of the sages and seers of past generations. They imagined that the primal man had fallen from some high estate; that he had forfeited by his own falseness, or been driven by some hard fate, from a pristine Paradise, an Eden garden, an Arcady; that his ancestors were demi-gods and heroes, himself their degenerate descendant.

How has prehistoric archæology reversed this picture! We know beyond cavil or question that the earliest was also the lowest man, the most ignorant, the most brutish, naked, homeless, half speechless. But the gloom surrounding this distant background of the race is relieved by rays of glory; for with knowledge not less positive we are assured that through all hither time, through seeming retrogressions and darkened epochs, the advance of the race in the main toward a condition better by every standard has been certain and steady, "ne'er known retiring ebb, but kept due on."

Archæology, however, is, after all, a dealing with dry bones, a series of inferences from inanimate objects. The color and the warmth of life, it never has. How can we divine the real meaning of the fragments and ruins, the forgotten symbols and the perished gods, it shows us?

The means has been found, and this through a discovery little less than marvelous, the most pregnant of all that anthropology has yet offered, not yet appreciated even by the learned. This discovery is that of the psychical unity of man, the parallelism of his development everywhere and in all time; nay, more, the nigh absolute uniformity of his thoughts and actions, his aims and methods, when in the same degree of development, no matter where he is or in what epoch living. Scarcely anything but his geographical environment, using that term in its larger sense, seems to modify the monotonous sameness of his creations.

I shall refer more than once to this discovery; for its full recognition is the corner stone of true anthropology. In this connection I refer to it for its application to archæology. It teaches us this: that when we find a living nature of low culture we are safe in taking its modes of thought and feeling as analogous to those of extinct tribes whose remains show them to have been in about the same stage of culture.

This emphasizes the importance of a prolonged and profound investigation of the few savage tribes who still exist; for, although none of them is as rude or as brute-like as primitive man, they stand nearest to his condition, and, moreover, so rapid nowadays is the extension of culture, that probably not one of them will remain untouched by its presence another score of years.

Another discovery, also very recent, has enabled us to throw light on the prehistoric or forgotten past. We have found that much of it, thought to be long since dead, is still alive and in our midst, under forms easily enough recognized when our attention is directed to them. This branch of anthropology is known as folk lore. It investigates the stories, the superstitions, the beliefs and customs which prevail among the unlettered, the isolated, and the young; for these are nothing less than survivals of the mythologies, the legal usages and the sacred rites of earlier generations. It is surprising to observe how much of the past we have been able to reconstruct from this humble and long neglected material.

From what I have already said, you will understand some of the aims of anthropology, those which I will call its "immediate" aims. They are embraced in the collection of accurate information about man and men, about the individual and the group, as they exist now, and as they have existed at any and all times in the past; here where we are, and on every continent and island of the globe.

We desire to know about a man, his weight and his measure, the shape of his head, the color of his skin and the curl of his hair; we would pry into all his secrets and his habits, discover his deficiencies and debilities, learn his language, and inquire about his politics and his religion, yes, probe those recesses of his body and his soul which he conceals from wife and brother. This we would do with every man and every woman, and, not content with the doing it, we would register all these facts in tables and columns, so that they should become perpetual records, to which we give the name "vital statistics."

The generations of the past escape such personal investigation, but not our pursuit. We rifle their graves, measure their skulls, and analyze their bones, we carry to our museums the utensils and weapons, the gods and jewels, which sad and loving hands laid beside them, we dig up the foundations of their houses and cart off the monuments which their proud kings set up. Nothing is sacred to us; and yet nothing to us is vile or worthless. The broken potsherd, the half knawed bone, cast on the refuse heap, conveys a message to us more pregnant with meaning, more indicative of what the people were, than the boastful inscription which their king caused to be engraved on royal marble.

This gleaning and gathering, this collecting and storing of facts about man from all quarters of the world and all epochs of his existence, is the first and indispensable aim of anthropologic science. It is pressing and urgent beyond all other aims at this period of its existence as a science; for here more than elsewhere we feel the force of the Hippocratic warning, that the time is short and the opportunity fleeting. Every day there perish priceless relics of the past, every year the languages, the habits and the modes of thought of the surviving tribes which represent the earlier condition of the whole species are increasingly transformed and lost through the extension of civilization. It devolves on the scholars of this generation to be up and doing in these fields of research; for those of the next will find many a chance lost forever, of which we can avail ourselves.

And here let me insert a few much needed words of counsel on this portion of my theme. Why is it that even in scientific circles so little attention is paid to the proper training of observers and collectors in anthropology?

We erect stately museums, we purchase costly specimens, we send out expensive expeditions; but where are the universities, the institutions of higher education, who train young men how to observe, how to explore and collect in this branch? As an eminent ethnologist has remarked, in any other department of science, in that, for instance, which deals with flowers or with butterflies, no institution would dream of sending a collector into the field who lacked all preliminary training in the line, or knowledge of it; but in anthropology the opinion seems universal that such preparation is quite needless.* Carlyle used to say that every man feels himself competent to be a gentleman farmer or a crown prince; our institutions seem to think that every man is competent to be an anthropologist and archæologist; and let a plausible explorer present himself, the last question put to him will be, whether he has any fitness for the job.

Hence our museums are crammed with doubtful specimens, vaguely located, and our volumes of travel with incomplete or wholly incorrect statements, worse than purely fictitious ones, because we know them to be the fruit of honest intentions, and therefore give them credit.

But, you will naturally ask, to what end this accumulating and collecting, this filling of museums with the art products of savages and the ghastly contents of charnel houses? Why write down their stupid stories and make notes of their obscene rites? When it shall be done, or as good as done, what use can be made of them beyond satisfying a profitless curiosity?

This leads me to explain another branch of anthropology to which I have not yet alluded, one which introduces us to other aims of this science quite distinct from those I have mentioned. That branch is Ethnology.

Ethnology in its true sense represents the application of the principles of inductive philosophy to the products of man's faculties. You are aware that philosophy proceeds from observed facts alone; it discards all preconceived opinions concerning these facts; it renounces all allegiance to dogma, or doctrine or intuition; in short, to every form of statement that is not capable of verification. Its method of procedure is by comparison, that is, by the logical equations of similarity and diversity, of identity and difference; and on these it bases those generalizations which range the isolated fact under the general law, of which it is at once the exponent and the proof.

By such comparisons, ethnology aims to define in clear terms the influence which the geographical and other environment exercises on the individual, the social group and the race; and, conversely, how much in each remains unaltered by the external forces, and what residual elements are left, defiant of surroundings, wholly personal, purely human. Thus, rising to wider and wider circles of observation and generalization, it will be able at last to offer a conclusive and exhaustive connotation of what man is—a necessary preliminary, mark you, to that other question, so often and so ignorantly answered in the past, as to what he should be.

Ethnology, however, does not and should not concern itself with this latter inquiry. Its own field is broad enough and the harvest offered is rich enough. Its materials are drawn from the whole of history and from pre-history. Those writers who limit its scope to the explanation of the phenomena of primitive social life only have so done because these phenomena are simpler in such conditions, not that the methods of ethnology are applicable only to such. On the contrary, they are not merely suitable, they are necessary to all the facts of history, if we would learn their true meaning and import. The time will come, and that soon, when sound historians will adopt as their guide the principles and methods of ethnologic science, because by these alone can they assign to the isolated fact its right place in the vast structure of human development.

In the past, histories have told of little but of kings and their wars. Some writers of recent date have remembered there is such a thing as the people, and have essayed to present its humble annals; but how few have even attempted to avail themselves of the myriad side lights which ethnology can throw on the motives and the manners of a people, its impulses and acquisitions!

It is the constant aim of ethnology to present its results free from bias. It deprecates alike enthusiasm and antipathy. Like Spinoza's God, nullum amat, nullum odit. Its aim is to compare dispassionately all the acts and arts of man, his philosophies and religions, his social schemes and personal plans, weighing and analyzing them, separating the local and temporal in them from the permanent and general, explaining the former by the conditions of time and place, referring the latter to the category of qualities which make up the oneness of humanity, the solid ground on which he who hereafter builds, "will build for aye."

This, then, briefly stated, is the aim of that department of anthropology which we call ethnology. In yet fewer words, its mission is "to define the universal in humanity," as distinguished from all those traits which are the products of fluctuating environments.

This universal, however, is to be discovered, not assumed. The fatal flaw in the arguments of most philosophers is that they frame a theory of what man is and what are the laws of his growth, and pile up proofs of these, neglecting the counter-evidence, and passing in silence what contradicts their hypotheses.

Take, for instance, the doctrine of evolution as applied to man. It is not only a doctrine but a dogma with many scientists. They look with theological ire on any one who questions it. I have already said that in the long run and the general average it has been true of man. But that we have any certainty that it will continue true, is a mistake; or that it has been true of the vast majority of individuals or ethnic groups, is another mistake. As the basis for a boastful and confident optimism it is as shaky as sand. Taken at its real value, as the provisional and partial result of our observations, it is a useful guide; but swallowed with unquestioning faith as a final law of the universe, it is not a whit more inspiring than the narrowest dogma of religious bigotry.

We have no right, indeed, to assume that there is anything universal in humanity until we have proved it. But this has been done. Its demonstration is the last and greatest conquest of ethnology, and it is so complete as to be bewildering. It has been brought about by the careful study of what are called "ethnographic parallels," that is, similarities or identities of laws, games, customs, myths, arts, etc., in primitive tribes located far asunder on the earth's surface. Able students, such as Bastian, Andree, Post, Stein-

* Address by Daniel G. Brinton, the retiring president of the American Association for the Advancement of Science, at the Springfield meeting, August, 1895.

† Professor James Ferrier, in his Institutes of Metaphysic.

* See the pertinent remarks of Dr. S. R. Steinmetz in the Einleitung to his Ethnologische Studien zur Ersten Entwicklung der Strafe. (Leiden, 1894.) I have urged this point further in a pamphlet entitled Anthropology as a Science and as a Branch of University Education in the United States. (Philadelphia, 1892.)

metz and others have collected so many of these parallels, often of seemingly the most artificial and capricious character, extending into such minute and apparently accidental details from tribes almost antipodal to each other on the globe, that Dr. Post does not hesitate to say: "Such results leave no room for doubt that the psychical faculties of the individual as soon as they reach outward expression fall under the control of natural laws as fixed as those of inorganic nature."*

As the endless variety of arts and events in the culture history of different tribes in different places, or of the same tribe at different epochs, illustrates the variables in anthropologic science, so these independent parallelisms prove beyond cavil the ever-present constant in the problem, to wit, the one and unvarying psychical nature of man, guided by the same reason, swept by the same storms of passion and emotion, directed by the same will toward the same goals, availing itself of the same means when they are within reach, finding its pleasure in the same actions, lulling its fears with the same sedatives.

The anthropologist of to-day who, like a late distinguished scholar among ourselves, would claim that because the rather complex social system of the Iroquois had a close parallel among the Munda tribes of the Punjab, therefore the ancestors of each must have come from a common culture center; or who, like an eminent living English ethnologist, sees a proof of Asiatic relations in American culture because the Aztec game of patolli is like the East Indian game of parchesi—such an anthropologist, I say, may have contributed ably to his science in the past, but he does not know where it stands to-day. Its true position on this crucial question is thus tersely and admirably stated by Dr. Steinmetz: "The various customs, institutions, thoughts, etc., of different peoples are to be regarded either as the expressions of the different stadia of culture of our common humanity; or, as different reactions of that common humanity under varying conditions and circumstances. The one does not exclude the other. Therefore the concordance of two peoples in a custom, etc., should be explained by borrowing or by derivation from a common source only when there are special, known and controlling reasons indicating this; and when these are absent, the explanation should be either because the two peoples are on the same plane of culture, or because their surroundings are similar."†

This is true not only of the articles intended for use, to supply the necessities of existence, as weapons and huts and boats—we might anticipate that they would be something similar, otherwise they would not serve the purpose everywhere in view; but the analogies are, if anything, still more close and striking when we come to compare pure products of the fancy, creations of the imagination or the emotions, such as stories, myths, and motives of decorative art.

It has proved very difficult for the comparative mythologist or the folk lorist of the old school to learn that the same stories, for instance, of the four rivers of Paradise, the flood, the ark and the patriarch who is saved in it, arose independently in western Asia, in Mexico and in South America, as well as in many intervening places, alike even in details, and yet neither borrowed one from the other, nor yet drawn from a common source. But until he understands this he has not caught up with the progress of ethnologic science.

So it is also with the motives of primitive art, be they symbolic or merely decorative. How many volumes have been written tracing the migrations and connections of nations by the distribution of some art motive, say the svastika, the maeander or the cross! And how little of value is left in all such speculations by the rigid analysis of primitive arts that we see in such works as Dr. Grosse's Anfange der Kunst, or Dr. Haddon's attractive monograph on the "Decorative Art of British New Guinea," published last year! The latter sums up in these few and decisive words the result of such researches pursued on strictly inductive lines: "The same processes operate on the art of decoration whatever the subject, wherever the country, whenever the age." This is equally true of the myth and the folk tale, of the symbol and the legend, of the religious ritual and the musical scale.

I have even attempted, I hope not rashly, to show that there are quite a number of important words in languages nowise related by origin or contact, which are phonetically the same or similar, not of the mimetic class, but arising from certain common relations of the physiological function of language; and I have urged that words of this class should not be accounted of value in studying the affiliations of languages.‡

And I have also endeavored to demonstrate that the sacredness which we observe attached to certain numbers, and the same numbers, in so many mythologies and customs the world over, is neither fortuitous, nor borrowed the one from the other; but depends on fixed relations which the human body bears to its surroundings, and the human mind to the laws of its own activity. And therefore, that all such coincidences and their consequences—and it is surprising how far-reaching these are—do not belong to the similarities which reveal contact, but only to those which testify to psychical unity.§

So numerous and so amazing have these examples of culture identities become of late years that they have led more than one student of ethnology into a denial of the freedom of the human will under any of the definitions of voluntary action. But the aims of ethnology are not so aspiring. It is strictly a natural science, dealing with outward things, to wit, the expressions of man's psychical life, endeavoring to ascertain the conditions of their appearance and disappearance, the organic laws of their birth, growth and decay. These laws must undoubtedly be correlated with certain mental traits, but it is not the business of the ethnologist to pursue them to their last analysis in the realm of metaphysics. For instance, we may trace all forms of punishment back to the individual's passion for revenge; or we may analyze all systems of religion until we find the common source of all to be man's dread of the unknown; and these will be sufficient ethnologic explanations of both these phenomena; but not a final analysis of the emotion of dread or the thirst for vengeance. Ethnology declines to enter these realms of abstractions.

I repeat that to define "the universal in humanity" is the aim of ethnology, that is, the universal soul or psyche of humanity.

But let me not be understood as speaking of this as of some entity, like the ame humaine of the Comtists. That were sophistical word mongering in the style of ancient scholasticism. There is no such entity as humanity, or race, or people, or nation. There is nothing but the individual man or woman, the "single, separate person," as Walt Whitman says. Hence some of the most advanced ethnologists are ready to give up the ethnos itself as a subject of study. Those terms so popular a few years ago, Volkerpsychologie, Volkergedanken, racial psychology, ethnic sentiments and the like, are looked upon with distrust. The external proofs of the psychical unity of the whole species have multiplied so abundantly that some maintain strenuously that it is not ethnic or racial peculiarities, but solely external conditions on the one hand and individual faculties on the other which are the factors of culture evolution.

While I admit that this question is still sub judice, I add that the position just stated seems to be erroneous. All members of the species have common human mental traits; that goes without saying; and in addition it seems to me that each of the great races, each ethnic group, has its own added special powers and special limitations compared with the others; and that these ethnic and psychic racial peculiarities attached to all or nearly all members of the group are tremendously potent in deciding the result of its struggle for existence.

I must still deny that all races are equally endowed, or that the position with reference to civilization which the various ethnic groups hold to-day is one merely of opportunity and externalities. I must still claim that the definition of the ethnos is one of the chief aims of ethnology; and that terms of this definition are not satisfied by geographic explanations. Let me, with utmost brevity, name a few other connotations, prepotent, I believe, in the future fate of nations and races.

None, I maintain, can escape the mental correlations of its physical structure. The black, the brown and the red races differ anatomically so much from the white, especially in their splanchnic organs, that even with equal cerebral capacity, they never could rival its results by equal efforts.

Again, there is in some stocks and some smaller ethnic groups a peculiar mental temperament, which has become hereditary and general, of a nature to disqualify them for the atmosphere of modern enlightenment. Dr. Von Buschan has recently pointed out this as distinctly and racially pathologic; an inborn morbid tendency, constitutionally recreant to the codes of civilization, and therefore technically criminal.

Once more, one cannot but acknowledge that the relations of the emotional to the intellectual nature vary considerably and permanently in different ethnic groups. Nothing is more incorrect than the statement so often repeated by physicians that the modern civilized man has a more sensitive emotional system than the savage. The reverse is the case. Since the dark ages, Europe has not witnessed epidemic neuroses so violent as those still prevalent among rude tribes.

These and a number of similar traits separate races and peoples from each other by well marked idiosyncrasies, extending to the vast majority of their members and pregnant with power for weal or woe on their present fortunes and ultimate destinies. The patient and thorough investigations of these peculiarities is, therefore, one of the most apposite aims of modern ethnology.

In this sense we can speak of the Volksgeist and Volkergedanken, a racial mind, or the temperament of a people, with as much propriety and accuracy as we can of any of the physical traits which distinguish it from other peoples or races.

For the branch of anthropology which has for its field the investigation of these general mental traits, the Germans have proposed the name "Characterology" (Karacterologie). Its aim is to examine the collective mental conditions and expressions of ethnic groups, and to point out wherein they differ from other groups and from humanity at large; also to find through what causes these peculiarities came about, the genetic laws of their appearance, and the consequences to which they have given rise.

This branch of anthropology is that which offers a positive basis for legislation, politics and education, as applied to a given ethnic group; and it is only through its careful study and application that the best results of these can be attained, and not by the indiscriminate enforcement of general prescriptions, as has hitherto been the custom of governments.

The development of humanity as a whole has arisen from the differences of its component social parts, its races, nations, tribes. Their specific peculiarities have brought about the struggles which in the main have resulted in an advance. These peculiarities, as ascertained by objective investigation, supply the only sure foundation for legislation; not à priori notions of the rights of man, nor abstract theories of what should constitute a perfect state, as was the fashion with the older philosophies, and still is with the modern social reformers. The aim of the anthropologist in this practical field is to ascertain in all their details, such as religions, language, social life, notions of right and wrong, etc., wherein lie the idiosyncrasies of a given group, and frame its laws accordingly.

Perhaps what I have said sufficiently explains the aims of ethnology. Some one has pertinently called it "the natural science of social life," because its methods are strictly those of the natural sciences, and its material is supplied by man living in society.

The final arbiter, however, to whom it appeals, is, I repeat, not the ethnos, not the social group, but the individual. I think it was Goethe who, nearly a century ago, uttered the pithy remark—"Man makes genera and species; Nature makes only individuals." Hence the justification of any result claimed by ethnology must come from the psychology of the individual; in his personal feelings and thoughts will be discovered the final and only complete explanation of the forms of sociology and the events of history. As I have elsewhere urged, man himself, the individual man, is the only final measure of his own activities, in whatever direction they are directed.*

On the other hand the only rational psychology—using that term as a science of the mental processes—must be the outcome of anthropology conducted as a natural science. For thousands of years other plans have been pursued. The philosopher would delve in his "inner consciousness;" the theologian would turn to his revelation; the historian would reason on his undigested facts; but the psychologist of the future, taking nothing for granted, will define the mentality of the race by analyzing each of its lines of action back to the individual feelings which gave them rise.

It is quite likely that some who have heard me thus far, and have agreed with me, are still dissatisfied. On their lips is that question which is so often put to, and which so often puzzles, the student of the sciences, cui bono? What practical worth have these analyses and generalizations which have been referred to?

Fortunately the anthropologist is not puzzled. His science, like others, has its abstract side, seemingly remote from the interests of the workaday world; but it is also and pre-eminently an applied science, one the practicality and immediate pertinence of which to daily affairs render it utilitarian in the highest degree.

Applied anthropology has for its aims to bring to bear on the improvement of the species, regarded on the one hand as groups, and on the other as individuals, the results obtained by ethnography, ethnology and psychology.

Such an improvement is broadly referred to as an increased or higher civilization; and it is the avowed aim of applied anthropology accurately to ascertain what are the criteria of civilization, what individual or social elements have in the past contributed most to it, how these can be continued and strengthened, and what new forces, if any, may be called in to hasten the progress. Certainly no aims could be more immediately practical than these.

Here again anthropology sharply opposes its methods to those of the ideologists, the dogmatists, and the deductive philosophers. It refuses to ask, What should improve man? but asks only, What has improved him in the past? and it is extremely cautious in its decision as to what "improvement" really means. It certainly does not accept the definition which up to the present the philosophies and theologies have offered; any more than it accepts the means by which these claim that our present civilization has been brought about.

This department of anthropology is still in its infancy. We are only beginning to appreciate that, in the future, political economy, like history, will have to be rearranged on lines which this new science dictates. The lessons of the past, their meaning clearly apprehended, will be acknowledged as the sole guides for the future. It may be true, as De Tocqueville said of the United States, that a new world needs a new political science; but the only sure foundation for the new will be the old.

Applied anthropology clearly recognizes that the improvement of humanity depends primarily on the correct adjustment of the group to the individual; and, as in ethnology, its ultimate reference is not to the group, but to the individual. In the words of John Stuart Mill, the first to apply inductive science to social evolution, it is that the individual may become "happier, nobler, wiser," that all social systems have any value.

We may profitably recall what the same profound thinker and logician tells us have been up to the present time the prime movers in human social progress. They are: First, property and its protection; second, knowledge and the opportunity to use it; and third, co-operation, or the application of knowledge and property to the benefit of the many.

But Mill was altogether too acute an observer not to perceive that while these moments have proved powerful stimulants to the group, they have often reacted injuriously on the individual, developing that morbid and remorseless egotism which is so prevalent in modern civilized communities. Nor should I omit to add that the remedy which he urged and believed adequate for this dangerous symptom is one which every anthropologist and every scientist will fully indorse—the general inculcation of the love of truth, scientific, verifiable truth.

It seems clear therefore that the teachings of anthropology, whether theoretical or practical, lead us back to the individual as the point of departure and also the goal. The state was made for him, not he for the state; any improvement in the group must start by the improvement of its individual members. This may seem a truism, but how constantly is it overlooked in the most modern legislation and schemes of social amelioration! How many even of such a learned audience as this have carefully considered in what respects the individual man has improved since the beginning of historic time? Is he taller, stronger, more beautiful? Are his senses more acute, his love purer, his memory more retentive, his will firmer, his reason stronger? Can you answer me these questions correctly? I doubt it much. Yet if you cannot, what right have you to say that there is any improvement at all?

To be sure there is less physical suffering, less pain. War and famine and bitter cold are not the sleuth hounds that they once were. The dungeons and flames of brutal laws and bigoted religions have mostly passed away. Life is on the average longer, its days of sickness fewer, justice is more within reach, mercy is more bountifully dispensed, the tender eye of pity is ever unscarfed.

But under what difficulties have these results been secured! What floods of tears and blood, what long wails of woe, sound down the centuries of the past, poured forth by humanity in its desperate struggle

* Dr. A. H. Post, "Ethnologische Gedanken," in Globus, Band 59, No. 19.

† Dr. S. R. Steinmetz, ubi supra, Einleitung.

‡ "On the Physiological Correlation of certain Linguistic Radicals." By D. G. Brinton. In the Proceedings of the American Oriental Society, March, 1894.

§ "The Origin of Sacred Numbers." By D. G. Brinton. In the American Anthropologist, April, 1894. In my Myths of the New World (New York, 1868, Chapter III, "The Sacred Number, its Origin and Applications"), I had shown the prepotency of the number four both in American and Old World mythology, ritual, statecraft, etc.

* "Man himself is the only final measure of his own activities. To his own force and faculties all other tests are in the end referred. All sciences and arts, all pleasures and pursuits, are assigned their respective rank in his interest by reference to those physical powers and mental processes which are peculiarly the property of his own species."—Anthropology as a Science, etc., p. 3.

for a better life! A struggle which was blind, unconscious of its aims, unknowing of the means by which they should be obtained, groping in darkness for the track leading it knew not whither.

Ignorant of his past, ignorant of his real needs, ignorant of himself, man has blundered and stumbled up the thorny path of progress for tens of thousands of years. Mighty states, millions of individuals, have been hurled to destruction in the perilous ascent, mistaking the way, pursuing false paths, following blind guides.

Now anthropology steps in, the new science of man, offering the knowledge of what he has been and is, the young but wise teacher, revealing the future by the unwavering light of the past, offering itself as man's trusty mentor and friend, ready to conduct him by sure steps upward and onward to the highest summit which his nature is capable of attaining; and who dares set a limit to that?

This is the final aim of anthropology, the lofty ambition which the student of this science deliberately sets before himself. Who will point to a worthier or a nobler one?

SOME HIGH MOUNTAIN OBSERVATORIES.

By Edward Whymper.

The observatory on the top of Ben Nevis is in some respects unique.* It is permanently inhabited, and it stands on the very highest point of Great Britain. There is no other country in the world having an inhabited observatory on its culminating point; and, though there are several so-called observatories at much greater elevations than Ben Nevis, the most elevated of them are "stations" where self-registering instruments are deposited, which are visited from time to time, and are not observatories having observers constantly in residence.

MOUNT WASHINGTON.

One of the earliest, if not the first, "summit station" which was occupied for meteorological purposes, and was permanently tenanted, was on Mount Washington, in New Hampshire, U. S. A., 6,286 ft. above the sea. It was established in 1870, jointly by the United States Signal Service and by Prof. J. Huntingdon. "Probably nowhere else in the world," says Mr. A. L. Rotch † (of the Blue Hill Observatory, in Massachusetts), "has such severe weather been experienced, the lowest temperature being here often accompanied by the highest winds." A special building was erected, which was open from 1874 to 1887; in the three following years it was occupied during the summer months only, and it is now closed altogether.

JANSSEN DRAGGED IN SLEDGE UP MONT BLANC.

Although the elevation of this station was not great, the difficulties of the observers were very considerable. The atmospheric conditions were somewhat similar to those on Ben Nevis. Temperature as low as —50° F. (ten degrees below the freezing point of mercury) was recorded, and this occurred when the wind, it is said, was blowing at the rate of 180 miles per hour! A still more remarkable statement is that the average hourly velocity of the wind for the month of January, 1885, was nearly fifty miles an hour! Frost accumulated on the anemometer during fogs to such an extent as to break off its arms and bring the instrument to a standstill, and to obviate this, so far as possible the cup wheel was changed every two hours in foggy weather. For nine months in the year the two signal officers and their cook were the only residents at the summit, and once or twice a month one of them went down for letters. These trips were not free from risks, and paralysis, it is said, seemed to result from close confinement. There was an occasion when one of the two observers died, and the other was alone with the dead body for a couple of days, as no one could come up on account of cold and wind. After that time it was customary to have three men always at the station. "The scientific results furnished by Mount Washington," says Mr. Rotch, "were disproportionate to the efforts expended to maintain the station during the seventeen years of its existence. This is largely due to the fact that the observations have not been published in detail"—a remark which is also true of various other observatories.

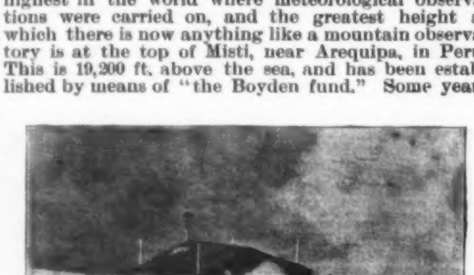
PIKE'S PEAK.

The Signal Service of the United States maintained for about fifteen years another mountain observatory on Pike's Peak, in Colorado, at the height of 14,134 ft. The building shown in the accompanying engraving was put up in 1873, ahd three telegraphic weather reports used to be sent daily to Washington; but in 1882 they were given up on account of cost, and in 1888 the station was closed. It was found here that temperature ranged from 64° F. to —39° F., that is to say, the extreme range amounted to 103° F. The velocity of the wind, however, was less than in most elevated places, and a rate of fifty miles an hour was seldom exceeded. This station is celebrated for "its electrical storms, which occur when the air is moist, and generally when a light, soft snow is falling. Sparks then emanate from the fingers of the outstretched hands, and the rotating anemometer cups look like a circle of fire." A paragraph has quite recently been going the round of the press describing the experiences of Lieut. Finley in an "electrical snowstorm" on Pike's Peak. "At first the flakes only discharged their tiny lights on coming in contact with the hair of the mule on which the lieutenant was mounted. Presently they began coming thicker and faster, each flake emitting its spark as it sank into drifts of the snow or settled on the clothing of the lieutenant or the hair of the mule. As the storm increased and the flakes became smaller, each of the icy particles appeared as a trailing blaze of ghostly white light. . . . When the storm was at its height and each flake of snow was like a drop of fire, electric sparks were shaken in streams from the lieutenant's finger tips, as well as from his ears, beard, and nose, and a wave of his arms was like the sweep of flaming sword blades through the air, every point of snow touched giving out its little snap and flash of light."

THE OBSERVATORY ON PIKE'S PEAK.
(14,134 feet.)

AREQUIPA.

The Pike's Peak station was for a long time the highest in the world where meteorological observations were carried on, and the greatest height at which there is now anything like a mountain observatory is at the top of Misti, near Arequipa, in Peru. This is 19,200 ft. above the sea, and has been established by means of "the Boyden fund." Some years ago, a Mr. Uriah A. Borden left a sum exceeding $230,000 in trust for the purpose of astronomical research "at such an elevation as to be free, so far as practicable, from the impediments to accurate observations which occur in the observatories now existing, owing to atmospheric influences." The trustees of the fund transferred the property to the president and fellows of Harvard College, in order that the researches proposed by Mr. Boyden might be directed at the Harvard College Observatory. The fund has been employed for meteorological purposes as well as for astronomical research. In the first instance, a station near Lima, in Peru, was temporarily occupied, at a height of 6,600 ft. Next, owing to the remarkable clearness of the air at Arequipa, it was decided to locate a permanent station at that place. Land was purchased outside the city, and buildings were erected in 1891. Arequipa is situated about eighty miles from the Pacific Ocean, in a river valley, and the observatory is built on the crest of a hill overlooking this valley, 8,050 ft. above the sea. Twelve miles away to the north there is a mountain called Charchani, about 20,000 ft. high, always snow capped; and ten miles to the northeast there is the dormant volcano Misti, 19,200 ft. high. The latter mountain has been frequently ascended of late years, and, notwithstanding its great elevation, presents little difficulty to those who are accustomed to mountain travel.



THE VALLOT OBSERVATORY ON MONT BLANC (14,321 feet) IN 1893.

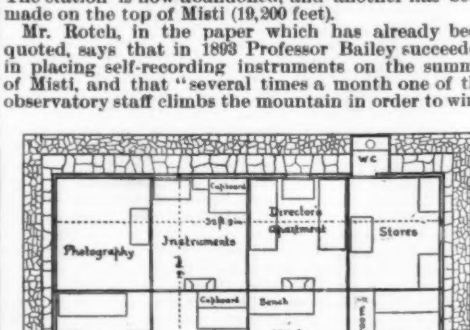
THE OBSERVATORY ON CHARCHANI.
(16,650 feet.)

CHARCHANI.

Not long after the establishment of the station at Arequipa, the observers began to cast eyes on Charchani. This part of South America is well adapted to astronomical work from the extreme purity of the air. A black spot one inch in diameter, placed on a white disk, could be seen on Charchani from Arequipa at a distance of eleven miles, through a thirteen inch telescope! It was decided to have a meteorological station on Charchani, and one was established there in 1892-3, just below the snow line, at the height of 16,650 ft. The position is so easy of access that mules can be driven right up to it. The mules, doubtless, if they could speak, would say that they do not like it; for at this height (16,650 ft.), where atmospheric pressure is only about sixteen inches and a half, instead of the thirty inches or thereabout to which we are accustomed, both beasts as well as men suffer. One visitor to Charchani says that, although he escaped the nausea and severe headaches which are generally experienced at this altitude, other symptoms manifested themselves "in abnormal excitability and restlessness which made sleep impossible, and by a lapse of memory as well as in a want of sequence of ideas." His rate of respiration, which at Arequipa was 20, rose to 25 per minute, and the pulse rate from 80 to 115.

The rainfall is small and the winds are light in this region. At Arequipa (8,050 feet) temperature descends to freezing point, and the extreme range of the thermometer has been found to be only 40·5° F. (79° maximum and 38·5° minimum). The highest velocity of the wind in 1891-2 was no more than seventeen miles an hour. On Charchani (at 16,650 feet) the lowest observed temperature was 13° F., and so far as one can judge from the published reports the extreme range of temperature is not great. Though dignified by the term "observatory," this Charchani station was on a very modest scale. The accompanying illustration renders description unnecessary. The instruments were placed in the louvered box on posts, and the contiguous hut was erected to shelter observers, if it was necessary to spend the night there. The ascent could be made on mule back from Arequipa in eight hours. The observers appear to have done no more than pay the observatory an occasional visit, and although it was admitted that all the meteorological data which are desirable would have been much more valuable if obtained in the free air on the summit of Charchani, they failed to scale this easy mountain. The station is now abandoned, and another has been made on the top of Misti (19,200 feet).

Mr. Rotch, in the paper which has already been quoted, says that in 1893 Professor Bailey succeeded in placing self-recording instruments on the summit of Misti, and that "several times a month one of the observatory staff climbs the mountain in order to wind the clocks and change the register sheets, at the same time taking check readings of standard instruments. Breaks in the record occur, owing to unforeseen stoppage of the instruments, or inability to make the ascent at the appointed time." "It is impossible," he says, "for persons to remain at these stations." There does not appear, however, to be any "impossibility" in residing at the top of Misti. From a relation of an



PLAN OF THE VALLOT OBSERVATORY.

* See the Leisure Hour for September, 1894, pp. 694-703.

† In a paper communicated to the Boston Scientific Society, March 26, 1895.

ascent given by Professor W. H. Pickering in Appalachia for March, 1894, the organ of the Boston Appalachian Mountain Club, it is evidently an unusually easy mountain. The professor, along with four others, rode on mules as high as 15,000 feet, and then went on foot to 18,440 feet, where they encamped. From this place, on the next morning, they reached the rim of the crater in twenty minutes. "The mountain," he says, "was certainly one of the easiest of descent that I have ever known. The motion was like skating, the loose stones rattling and sliding after one, and the finer particles following in a cloud of dust. Each step was between one and two yards in

DR. JANSSEN.

length, and I reached the base of the cone from the edge of the crater inside of fifty minutes. The tambo was reached half an hour later, and I had descended over 5,000 feet inside of one hour." No such pace as this can possibly be attained on a mountain unless it is of the very easiest character.

MONT BLANC.

The difficulties in forming such "stations" as those upon Charchani and Misti are trifling compared with those which have been overcome in establishing the two existing observatories on Mont Blanc, one at the height of 14,320 feet and the other on the summit (15,780). The former of these enterprises is due to a Parisian, Monsieur J. Vallot, and the latter to Dr. Janssen, Director of the Observatory at Meudon. M. Vallot is a mountain enthusiast, and in 1887 performed the unprecedented feat of camping under canvas on the summit for three days and nights. Until he did so, only one person had encamped there before, namely Dr. Tyndall, and his experiences were particularly unhappy. Both he and the whole of his guides were incapacitated by mountain sickness, and they came down the next morning in a forlorn state, having accomplished nothing. This occasion is well remembered at Chamonix, and M. Vallot found great difficulty in persuading anyone to go with him. When they at last started he was accompanied by M. Richard and a caravan of guides and porters—in all nineteen persons. So far as the commencement of the ridge of the Bosses du Dromadaire* (that is, to about the height of 14,000 feet) they got along all right; but then M. Richard, who was not accustomed to mountain walking, began to flounder. A little higher up one of the porters became incapable, and by the time the summit was reached M. Vallot himself was seized with vomiting and was obliged to lie down on the snow, exhausted. The porters, after having deposited their loads on the summit, were sent back to Chamonix, while MM. Vallot and Richard, with two guides, remained on the top during three days occupied in meteorological and other obser-

FREDERIC PAYOT IN WINTER DRESS.

vations. Their experiences, which were detailed at length in the "Annuaire" of the French Alpine Club, were very curious. They found themselves entirely without appetite, and unable to eat. Even a cup of tea "produced a disastrous effect." On the third night one of the guides went out of the tent for a moment, and returned in a great state of alarm, saying that the air was full of electricity. Vallot went out to see, and says that from the tent, from the erection sheltering the instruments, and from himself, "a harsh rustling proceeded, caused by thousands of sparks. My hairs stood on end, and each individual one seemed to be drawn away from me separately. The sparks were felt all over the body; one couldn't remain outside without suffering; we were literally bathed in electricity."

The foundation of the Vallot Observatory was a result of this journey. At first, M. Vallot thought of having a cavern excavated in some of the highest rocks; but he abandoned this idea, and decided to put up a wooden chalet a little below the lower of the two snowy humps which are called the Bosses du Dromadaire, at the height of 14,320 feet above the sea. Difficulties arose at the outset, for the Commune of Chamonix lays claim to the French side of Mont Blanc, and no buildings can be erected without consent. Permission was ultimately granted on rather harsh terms. The Chamoniards apprehended that M. Vallot might turn his establishment into a sort of auberge, which would be detrimental to their interests in the inn on the Grands Mulets, and stipulated that he should erect a refuge as an adjunct to his observatory, at his own expense. This was to become their property, and they were to have the right of taxing all persons ten francs who stopped there for a night, half of the receipts being destined to pay for the maintenance of the refuge and half were to go to their lessee at the Grands Mulets for the injury which it was supposed might be done him. On these conditions M. Vallot was allowed to erect his observatory. He established a refuge to conciliate the commune, and the commune finds it impossible to collect the tax.*

The materials of the building were ready at Chamonix by the beginning of June, 1890, and then the more serious task had to be undertaken of their transportation to the height of 14,300 feet, for the larger part of the way, over snow or ice, on men's backs. One hundred and ten of the guides and porters had agreed to carry a load apiece up to the selected spot; but when all was ready the weather went to the bad, and rendered a start impossible; and when it improved the guides became occupied in conducting tourists. Still, by the end of July, the building was erected on the position which had been chosen for it, on solid rock.† At first it was a very small affair, measuring about 16 × 13 feet, and 10 feet high, a portion of which was "observatory" and the rest "refuge;" but it has grown to the proportions shown on the annexed plan. The transport of the materials and their erection on the spot were far more onerous than the actual con-

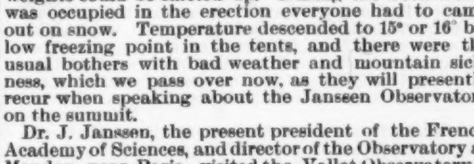


FIG. 1. FIG. 2. FIG. 3.

THE EDICULE.

struction of the building in the first instance. Chamoniards consider 35 lb. the maximum load for a man on Mont Blanc, and in all the details attention had to be given to that point. No large timbers or heavy weights could be carried up. During the week which was occupied in the erection everyone had to camp out on snow. Temperature descended to 15° or 16° below freezing point in the tents, and there were the usual bothers with bad weather and mountain sickness, which we pass over now, as they will presently recur when speaking about the Janssen Observatory on the summit.

Dr. J. Janssen, the present president of the French Academy of Sciences, and director of the Observatory at Meudon, near Paris, visited the Vallot Observatory a few weeks after it was put up, to carry on spectroscopic observations. He was detained there several days by violent storms, but he ultimately ascended to the summit of Mont Blanc, and got back to Chamonix in safety. The journey occupied him from August 17 to August 23. He was struck with the advantages to science which might be expected from working in pure air, and on his return to Paris communicated an account of his journey to the Academy of Sciences, at the meeting on September 22, 1890. He concluded by saying: "I think it will be of the first importance for astronomy, for physics, and for meteorology that an observatory should be erected on the summit, or at least quite close to the summit of Mont Blanc. I know that objections will be brought forward as to the difficulty of erecting such a building upon so high a spot, which one can only reach with much trouble, and which is often visited by tempests. These difficulties are real, but they are not insurmountable. I cannot enter deeply into the matter now, and content myself with saying that with the means our engineers can put at our disposal, and with such mountaineers as we possess at Chamonix and in the neighboring valleys, the problem will be solved whenever we wish."

From that time until now Dr. Janssen has been more or less occupied in solving the problem.

In a very short time the necessary funds were subscribed by some of his wealthy and influential friends. Among his supporters were Prince Roland Bonaparte, M. Bischoffheim and Baron Adolphe de Rothschild, M. Leon Say and the late president of the republic.

The execution of the project was a work of much greater difficulty. There is no visible rock at the immediate top, and it was proposed to build upon the snow. This idea was received with almost universal incredulity. The general opinion was distinctly unfavorable. "The persons," said Dr. Janssen, "who were best acquainted with the glaciers of this great mountain considered that it was quite impossible to establish a building on the summit, such as would serve for observation and residence. They said, and with apparently much force, that the thickness of the snowy crust would prevent foundations being obtained in solid rock, and they would not admit the possibility of establishing the building on snow."

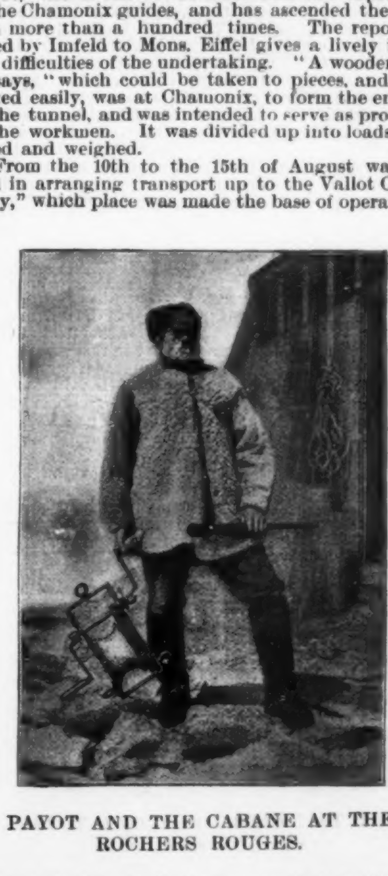
Mons. Eiffel, of tower fame, was taken into consultation, and declared himself ready to construct an observatory on the very top of Mont Blanc, if a rock foundation could be found not more than fifty feet below the surface of the snow, and expressed his willingness to bear the cost of the preliminary operations.

EXTERIOR OF JANSSEN'S OBSERVATORY IN JULY, 1894.

It so happens that rocks peep through the snow on three different sides of the summit, no great distance below it—small patches, scarcely visible from below. One, called la Tournette, is about one inch to the right of the summit in the engraving on page 617. Another, named les Petits Mulets, is about a quarter of an inch below the summit in the same illustration. The third, called la Tourette, is on the opposite side of the mountain, and cannot be seen. These rocks which peep through the snow are either summits of Aiguilles, or points on ridges of Aiguilles. But it is exceedingly unlikely that the highest points of the Aiguilles are exposed. They are, in all probability, somewhere underneath the summit ridge, which appears to be placed at the junction of three or more rocky ridges; and as the little patches of rock which do appear on the three sides are only 454 feet (la Tournette), 392 feet (Petits Mulets), and 171 feet (la Tourette) below the extreme top of Mont Blanc, there was at least a possibility that rock might be struck.

Mons. Eiffel committed the direction of this affair on the spot to Mons. X. Imfeld, a Swiss, who is well known as a surveyor, and as manager of one of the hotels at Zermatt. A more competent man for the purpose could scarcely have been found. Imfeld had a horizontal gallery driven into the snow forty-nine feet below the summit, on the French side, and employed as director of the workmen Frederic Payot, who is one of the most able and experienced of the Chamonix guides, and has ascended the mountain more than a hundred times. The report rendered by Imfeld to Mons. Eiffel gives a lively idea of the difficulties of the undertaking. "A wooden hut," he says, "which could be taken to pieces, and transported easily, was at Chamonix, to form the entrance to the tunnel, and was intended to serve as protection to the workmen. It was divided up into loads, numbered and weighed.

"From the 10th to the 15th of August was occupied in arranging transport up to the Vallot Observatory," which place was made the base of operations.



PAYOT AND THE CABANE AT THE ROCHERS ROUGES.

August 13, 1891.—A first caravane started with part of the hut and provisions for the Rochers des Bosses.

August 14.—I went with Fred. Payot and the rest of the porters as far as the Grands Mulets.

August 15.—We reached the Vallot Observatory at 9 A. M. and the summit at midday. I settled the position for the mouth of the tunnel, the direction of its

* The names of places which will be mentioned will be found on the map of Mont Blanc, given at p. 619 of the present volume of the Leisure Hour.

* In the first instance, the "refuge" was a portion of the observatory buildings. Subsequently a separate hut was erected as a refuge a few hundred yards away from the observatory.

† The position is marked on the map.

axis; and with six workmen arranged the clearing away of the snow to place the hut.

August 16.—On account of a "tourmente" of snow, no one could leave the observatory.

August 17.—The work done on the 15th of August was partly buried under the snow. It was restored by six workmen and the tunnel was commenced. Advanced 5 meters. In the evening one of the workmen (Jos. Simond) came back ill from the summit. He had a frostbitten foot and several toes were without sensibility when pricked with needles. Our doctor, Dr. Egli, of Zurich, gave him the necessary care. Fearing consequences, he wouldn't entertain my suggestion that the man should be sent down to Chamonix.

August 18.—The workmen, discouraged by the illness of their comrade and by want of space and coverings in the Vallot cabane, and bored by numerous visits of tourists, demanded a rise in their daily wages from 16 to 30 francs. After a long discussion I offered 20 francs, conditionally on confirmation. One man stuck to his demand and was dismissed. The others remained and continued work in the tunnel. Advanced 5 meters. At the distance of 16 meters from the stake (at the mouth) a prune stone was found.

August 19.—Very high wind. All the workmen went down to the Grands Mulets to fetch portions of the hut which had been left behind by the contractors and for wood to burn and provisions.

August 20.—The workmen were driven back on the Grande Bosse by a very strong north wind and could not reach the tunnel.

August 21.—Very great "tourmente" of snow. Impossible to get to the summit. The porters don't come up. Five workmen decide to go down to the Grands Mulets to get food. Along with them went a tourist (M. Rothe) with his guide and tied on to the rope of the workmen. Upon the Petit Plateau an ice avalanche fell from the top of the Dome du Gouter on to the party and killed the tourist and his guide. My workmen escaped with slight bruises and went on the same evening to Chamonix.

August 22.—Violent storm. Could not leave the observatory. The porters don't come up.

August 23.—Snow falling. At 2 P. M. arrival of Fred. Payot and five porters laden with food and wood. They bring the first news about the accident on the 21st and the information that the workmen are discontented and have gone down to Chamonix and won't come up again. As the porters who had arrived were not engaged as workmen, I directed Fred. Payot to go down to Chamonix to procure fresh workmen. He left the observatory accompanied by Dr. Egli and a porter, but they came back in half an hour on account of the violence of the "tourmente."

August 24.—Much new snow. Wind cold. In the afternoon I decided to try to get to Chamonix along with Dr. Egli, Payot and a porter. Got the same evening to the Grands Mulets.

August 25.—Arrived at Chamonix at 10 A. M. In the course of the day engaged six workmen.

August 26.—The workmen went up with Fred. Payot to the Grands Mulets.

August 27.—Fred. Payot and the workmen, carrying provisions, went from the Grands Mulets to the Rocher des Bosses.

August 28.—Bad weather. The workmen couldn't get to the summit. I start in the afternoon with Dr. Jacottet, of Chamonix, who wished to make an ascent of Mont Blanc, on which he had failed twice, and he offered to give his services gratuitously, in case of need, during the time he remained at the Vallot cabane.

August 29.—The workmen reached the summit. Advance 5·3 meters. One man was sent down to Chamonix ill from mountain sickness and another came back with a slightly frostbitten foot.

August 30.—Fred. Payot and four workmen continue the tunnel. Advance 5·4 meters.

August 31.—Snow storm. The summit is impracticable.

September 1.—Fine weather. Along with Dr. Jacottet, at 9 A. M. we were on the summit. Photographed the panorama. Probed the rock of la Tourette, and also the Petits Mulets and Rochers Rouges. Advance 1·8 meters. One workman (Jules Simond) had his fingers frostbitten.

September 2.—Early in day it was found that Jos. Simond, Jules Simond and Jos Charlet were unable to work (from frostbitten fingers and feet, and mountain sickness). They were sent down to Chamonix. Dr. Jacottet unwell (inflammation of the lungs and brain), and I remained at the observatory to look after him, while Fred. Payot, and all the rest went to the summit to fix up the hut at the entrance to the tunnel. About 4 P. M. the condition of Dr. Jacottet got worse (delirium). At 5.30 P. M. he lost consciousness, and he died in the course of the night, at 2.30 A. M.

September 3.—Conveyal of the corpse of Dr. Jacottet to Chamonix. Consultation with M. Janssen upon the information obtained by probing (sounding), and continuation of the same.

September 4.—By telegram to-day, you announce your intention of suspending the work.

September 4-8.—Examination of accounts, paying off guides, porters, workmen, etc.

The net result was that a gallery 96 feet long was driven, and in the whole course nothing more rocky was found than a prune stone! M. Eiffel retired from the undertaking, but Dr. Janssen had the gallery carried on by Payot 75 feet farther, at an angle of forty-five degrees to its former course, still without finding rock, and he then decided to erect his observatory on snow, and on the highest point of the summit ridge.

Two important questions, he admitted, required first of all to be elucidated. One was, will the observatory, if placed on the summit snow, sink or swim? The other was, what movements are there to dread in this snowy cap? To obtain an answer to the first question, an experiment was carried out at Meudon. A column of lead weighing 792 pounds, but only one foot in diameter, was placed on piled up snow, brought to the density of that at the summit. The lead is said to have sunk in less than an inch, and Dr. Janssen considered this result encouraging. "As to the question of the movements," he said, "it was studied and determined by the installation in 1891 of a wooden edifice, which has now been two years on the spot." This edifice, which they term "the edicule," has now been in position for four years, but I do not feel that it has yet settled the "question." The little building is about six feet high from floor to roof, and a post at each corner is carried down six feet more. To install it, in 1891, a hole was dug; the level of the floor was made to coincide with the level of the summit, and the snow was then filled in again. Its appearance then was that of Fig. 1 in the annexed diagram. In 1892 it was noticed that the floor was beneath the general level of the summit, and that on one side the snow rose in a sort of bank to nearly half the height of the hut (see Fig. 2).

On August 8, 1893, I visited it, and found that only 2 feet 3 inches rose above the summit of Mont Blanc (see Fig. 3). In July, 1894, I visited it again, and found it in much the same condition; but the snow had been recently trampled down, and, I imagine, a good deal had been cleared away. The level of the gallery is already more than 46 feet below the summit, and this is a significant fact, affording a practical demonstration that the snows at the top of Mont Blanc are constantly descending to feed and maintain the glaciers below. The summit in 1891 was not the summit in 1892, nor will that of 1895 be the summit of 1896. The height of the mountain, nevertheless, remains nearly constant by the accession of fresh snow. It is not the liability of sinking into the snow, but the strong probability that any building erected on the top will sink with the snow, which gives rise to apprehension about the stability and maintenance of Dr. Janssen's Observatory.

He is not, however, dismayed by this prospect, and has constantly pressed forward the building to completion. In the winter of 1891–1892 the observatory (partly of iron and partly of wood) was constructed at Meudon, was taken to pieces and forwarded to Chamonix, and in the course of the latter year was transported up the mountain, under the management of Frederic Payot. By the end of the season about one quarter of the materials had been advanced to a little patch of rocks 750 feet below the summit, and the rest so far as the Grands Mulets. There they remained for the winter. The early part of 1893 was occupied in recovering the depot which was buried under 25 feet of snow, and in bringing up the remainder of the materials. By the end of 1893 the building was erected on the summit, its heavier portions having been hauled up the terminal slope of snow, called the Calotte, by means of little windlasses, such as Payot is holding in the accompanying engraving. The building, however, was not completed until the end of 1894. When I visited it in July of that year it was more than half filled with snow, and two days of hard work were employed before it became tenantable. At that time no instruments had been sent up.

Dr. Janssen has shown an energy, courage and tenacity in the prosecution of his undertaking which would be remarkable in anyone, and are doubly so in a man verging on threescore and ten, who is unable to climb a yard, and who is so badly lame as to walk with difficulty even on level ground. Twice already he has had himself dragged to the summit in the manner shown in the illustration at the head of this article. On the second occasion economizing the strength of his men on steep places by using the windlasses which had already been employed to haul the materials.

The time has now arrived for the installation of instruments. The principal one that is destined for the observatory is termed a meteorographe, and has been constructed by Richard, of Paris, at a cost of £750. It registers barometric pressure, maximum and minimum temperatures, the direction and force of the wind, etc. It is put in movement by a weight of 200 pounds, which descends about 20 feet and is calculated to keep everything going for eight months—the length of time during which it may sometimes be left to itself. In introducing his huge instrument to the Academy of Sciences on August 13 1894, Dr. Janssen said, "I do not conceal from myself that, notwithstanding the minute precautions which have been taken, there must be some degree of uncertainty about the result." One possibility need only be mentioned. The barometer that will be employed will be a mercurial one of the Gay-Lussac pattern. Until now, the minimum temperature that occurs on the summit of Mont Blanc during winter has been unknown. Last winter, however, thermometers were placed in the interior and on the exterior of the observatory, and this year it has been found that the former registered —35·2° Centigrade and the latter —43° C., as the greatest degrees of cold. These temperatures are respectively equal to —31·36° and —45·4° Fahrenheit. The former is dangerously near to the freezing point of mercury (—40° F.), and if temperature in the interior of the observatory should on some future occasion fall a little lower than it did last winter, the barometer will cease to act just at a time when it would be particularly interesting to have it in operation. The installation of this instrument and a large telescope will be among the most important pieces of work which will be undertaken at the Mont Blanc Observatory this year. Perhaps before these pages are published the great meteorographe will be in action, and it is to be hoped that such results will speedily ensue as will be commensurate with the thought and labor which have been bestowed upon this difficult enterprise.—Leisure Hour.

A PERUVIAN SALT MINE.

Description of a deposit of salt on the west coast of Peru, about 60 miles north of the port of Callao. The salt field is about four miles by three, in a level tract at or below sea level, separated from the sea by a narrow sandy strip containing shallow lagoons.

The deposit varies in thickness from a few inches to over 15 ft., lying in irregular depressions, often covered by drift sand. An efflorescence of white salt usually distinguishes the sand-covered salt from the portions of the area which are entirely sand. The massive salt below is often nearly pure; but on the surface, sometimes above the sand, a layer of "caliche" or sodium nitrate, some inches thick, often occurs. The amount of salt is very great, but the small extent of the workings prevents any accurate estimate of it being made yet.

For many purposes the salt is pure enough as it is taken out of the beds. Where purer salt is wanted, the surface material is excavated, and water from the lagoons let into the pit so made by digging channels; this water saturates itself with salt, and on spontaneous evaporation, leaves a layer of practically pure salt. This layer, after one or more, usually two, years of this treatment, is cut into blocks 18 or 20 in. square, and 8 or 10 in. deep, which are drained and dried, and carried on a small railway to the nearest harbor for shipment. The cutting up is now done by axes, but it is intended to use channeling machines to lessen the waste.

There are four grades of salt: "Sal Corriente," prepared as described, pure and rather soft; "Sal de Corazon," the older salt, from the older layers, after removing the Sal Corriente, harder, less pure and coarsely crystalline; "Sal de Espuma," the efflorescence above spoken of, pure, but occurring in small quantity only; the fourth grade, coarsely crystalline, from the portions of the deposit below water level.—Robert Peele, Jr., School of Mines Quarterly.

THE ENERGY OF RAIN STORMS.

The conditions that tend to cause a rainfall are not of an unusual character. The formation of a cloud seems to be due to the partial saturation of a mass of air with aqueous vapor, which, rising into the atmosphere, becomes by a natural process expanded and in part condensed, thus producing the well known cloud formations. The amount of vapor contained in a given volume of air varies according to its position with respect to the earth. At the seashore a mass of vapor occupying one cubic meter of space and having a temperature of 20° C. (68° F.) contains about 17·1 grammes of water. If this mixture of air and moisture be lifted to a height of 3,500 meters, it will have only 9·6 grammes per cubic meter. Further calculations would show that at 4,200 meters in height there are 8·2 grammes, and at 8,500 meters or approximately 25,500 feet, about four to five miles above the earth, a cubic meter contains only 3·9 grammes of cloud matter.

The amount of material thus set in motion by the process of condensation can be to some extent calculated. The area of a rain belt or of an ordinary localized storm can be determined with a fair degree of exactitude. The energy residing in a mass of desiccated liquid at such enormous heights can be faintly estimated. Its potential energy loses when it becomes kinetic, due to the friction of the air, but each little drop tends to bring about a large sum total of considerable significance. The velocity of a body falling into a non-resisting medium would be

$$v = \sqrt{2\,g\,h},$$

where v = velocity per second,
g = 32·2 feet = acceleration,
h = height in feet,

by which the velocity due to any height can be determined. The energy given out by a moving body falling through any distance is dependent upon the velocity of the body and can be ascertained by the formula

$$w = \frac{1}{2}\,m\,v^2$$

where w = work,
m = mass.

So that a sheet of rain drops descending through thousands of feet of space could impart an immense amount of energy to a body designed to receive and utilize its force.

The theoretical velocity of a drop falling from a height of 10,000 feet would be

$$v = \sqrt{2 \times 32{\cdot}2 \times 10{,}000}$$
$$= 802 \text{ feet per second.}$$

The work done by one pound of water in falling from such a height would be

$$w = \frac{1}{2} \times 1 \times 644{,}000$$

$= 322{,}000$ foot pounds, and the time required for it to fall would be

$$t = \sqrt{\frac{2\,h}{g}}$$
$$= \sqrt{\frac{2 \times 10{,}000}{32{\cdot}2}}$$
$$= 24{\cdot}9 \text{ seconds.}$$

Should a storm continue for many hours the number of inches of water that has fallen would enable us, by knowing the area of the storm, to compute the mass in pounds, and this mass falling from a height of any number of feet would be capable of delivering an amount of energy calculable by the above methods.

One ton of water would deliver foot pounds equal to

$$\frac{1}{2} \times 2{,}000 \times [10{,}000]^2 = 100{,}000{,}000{,}000$$

if falling from a height of 10,000 feet in the air.

The rain fall in London is 23·5 inches, or about two feet. The foot pounds delivered in a year could be determined by considering an average area of so many square miles as the seat of the most rain, and thus obtaining the cubic feet and weight of water that has fallen. If a general mean average of 10,000 feet be settled upon for the value of h, then the energy delivered per 10,000 miles of country can be found.

A district 100 × 100 miles would contain an area of $278{,}784 \times 10^6$ square feet, and comprise in the neighborhood of London for fifty miles on each side a volume of water equal to $557{,}568 \times 10^6$ cubic feet. At 62½ pounds per cubic foot the weight of water per annum in such an area would be $174{,}244 \times 10^5$ tons or over 17,000,000,000 tons, and the foot pounds of energy in such a mass falling from 10,000 feet would be $174{,}234 \times 10^{12}$, or almost two million hundred billion foot pounds, or six hundred thousand hundred million horse power per year. The energy of a passing shower is nothing more than the sun's consuming rays alive once more. Both the drooping flower and the raging torrent look forth alike to its beneficent influence.

In the mysterious economy of nature there is nothing more unspeakably beautiful than this great and continual resurrection—nothing that so betrays the resistless changes and unresting weariness of our own persistent lives. We find the above in Electrical Age, the original source not stated.

[FROM THE SAN FRANCISCO EXAMINER.]

FOUR LITTLE SKY TRAVELERS.

By Professor E. E. BARNARD.

BETWEEN the orbits of the planets Mars and Jupiter is situated a zone of very small planets. At least 400 of these little bodies are now known, and they doubtless exist by thousands. How small the smallest of these may be cannot be even estimated. Possibly there may be multitudes of them not larger than grains of sand, but such, of course, we can never see. The smallest that have been discovered are possibly not above ten miles in diameter. The first four discovered of these bodies, however, are of considerable dimensions, and form respectable but modest sized worlds. The first one of these objects known was discovered January 1, 1801, by Piazzi, of Palermo, in Sicily. He named it Ceres after the tutelary goddess of Sicily. It was found to be revolving around the sun in a period of four and sixth-tenths years at a mean distance of 256 millions of miles. A second, third and fourth were found in the years 1802, 1804 and 1807, respectively, by Olbers and Harding, the former discovering two. These were named Pallas, Juno and Vesta. It was suggested by Olbers that possibly these were fragments of a great planet once existing between Mars and Jupiter that had for some unknown reason burst asunder. A further and immediate search did not reveal any more of the "fragments."

Nearly forty years afterward, however, Hencke, after a long search of many years, began anew the discovery of these small planets in 1845, since which time their discovery has been rapid. Especially has the discovery increased enormously in the past three years through the agency of photography. What their origin is due to we do not know. It is not probable, however, that they are the results of the burstings of any one planet, as suggested originally by Olbers.

These bodies have been variously called asteroids—minor planets, etc. They are so small that in ordinary telescopes they appear only as stellar points, without any sensible or measurable disks. Various efforts have been made to determine the dimensions of the brighter ones. The work has been principally based upon a consideration of their light. The quantity of light they reflect is more or less directly measurable.

We know the quantity of light the planets reflect and we know their dimensions. By assuming, therefore, that an asteroid's surface reflects light as intensely as that of some known standard, say the surface of Mars, we can from the known dimensions of Mars deduce the diameter of the asteroid by measuring its brightness.

This, however, is a very uncertain method, for if the surface of the asteroid is more highly reflective than that of our standard, the deduced diameter will be too great, and vice versa.

If we compare the albedos or reflective powers of the different planets, we find a very wide range of albedo So that if the diameter of any one of them were determined by comparing its light with any of the others, a very erroneous value would be obtained. For instance, Venus has a very highly reflective surface. It reflects light five times as intensely as the surface of the planet Mercury. Therefore, if we should determine the diameter of Mercury photometrically, on the assumption that its albedo was the same as that of Venus, we should get a diameter entirely too small.

However, if the size of a celestial body is too small to permit direct measurement, some idea of its size may be had more or less roughly from its stellar brightness.

Dr. Muller, of the Astro-Physical Observatory, at Potsdam, in Germany, has for many years photometrically observed some of the brightest of the asteroids. From these observations he has deduced their diameters on two assumptions. First, that they reflect light surface for surface as intensely as does the planet Mercury. Second, that their albedo is equal to that of Mars.

On the latter assumption he deduces diameters for Ceres and Vesta that are 120 miles greater than with the first assumption. Yet his assumed standards—the albedos of Mercury and Mars—have a comparatively small range. In the case of Vesta he makes its diameter nearly three times as great as it really is, through having assumed its albedo equal to that of the planet Mercury.

Yet these results of Dr. Muller are certainly the most trustworthy of any obtained by the photometric method.

Some efforts have been made to measure directly the diameters of the four brightest of these bodies. At best, however, these have been but mere guesses, since the instruments used were entirely inadequate to deal with such minute quantities as the diameters of the asteroids. Especially are the earlier attempts in this line extremely discordant.

Schroter measured the diameter of Ceres, and made it 3,025 miles. About the same time Sir William Herschel found from his measures that it was about 100 miles in diameter.

There are not more than one or two instruments in the world capable of properly measuring these small planets. They have apparently not attempted the work, having hopelessly given the asteroids over to the photometric methods. It is of the highest importance, however, that a true knowledge of the dimensions of some of the asteroids should be had.

On examining Ceres, Pallas, Juno and Vesta with our thirty-six inch telescope, I found that they presented readily measurable disks, and that their diameters with this noble instrument could be determined with much certainty. I therefore took up their measurement, and have carried on the work for the part two years. The results of this work have just been sent to the Royal Astronomical Society of Great Britain at London. We now know for the first time the true dimensions of these four asteroids.

I have thought these results might be of considerable popular interest if stated briefly. The following are the diameters from the two years' work with the thirty-six inch:

DIAMETERS.

Ceres	485 miles.
Pallas	304 "
Juno	118 "
Vesta	243 "

These will be very close to the true dimensions. Juno was very difficult, from its extremely small size. It was at the limit of measurement with the great telescope.

Astronomers have always considered Vesta as the largest of the asteroids, because it was the brightest. In reality it is third in size, Ceres being by far the largest. For some reason the surface of Vesta is highly reflective. Its albedo is four times as great as that of Ceres.

Assuming the albedo of Mars to equal 1·00, I have from my measures of these asteroids computed their albedos. These are:

Albedo of Ceres	0·67
Albedo of Pallas	0·88
Albedo of Juno	1·67
Albedo of Vesta	2·77

Muller has determined the albedos of the planets, which are as follows:

Albedo of Mercury	0·64
Albedo of Venus	3·44
Albedo of Mars	1·00
Albedo of Jupiter	2·79
Albedo of Saturn	3·28
Albedo of Uranus	2·73
Albedo of Neptune	2·36

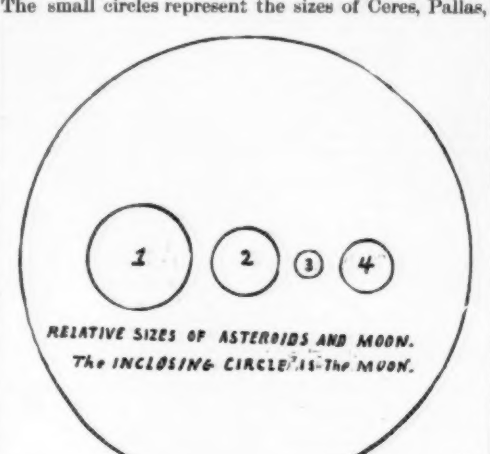
That is to say, he has found that the surface of Venus reflects light 3·44 times stronger than that of Mars, etc.

By comparing these albedos of the planets with my results for the asteroids, we learn that the surface of Ceres reflects light, area for area, about as intensely as that of Mercury, Pallas somewhat less than that of Mars. Juno between Mars and Jupiter, while the surface of Vesta is as highly reflective as that of Jupiter.

The high albedo of Vesta accounts for its greater brightness compared with its small size. This also accounts for the erroneously large diameter attributed to it from photometric observation.

Besides their proper names, the asteroids have each a number assigned them in the order of their discovery. These four are known as Ceres (1), Pallas (2), Juno (3) and Vesta (4).

To show more graphically the relative sizes of these asteroids from my measures of their diameters, I have made the inclosed diagram, which will speak for itself. The small circles represent the sizes of Ceres, Pallas,



Juno and Vesta, as indicated by their numbers—1, 2, 3, 4. The large inclosing circle represents the size of our moon drawn to the same scale. This perhaps gives the best idea of their real minuteness.

E. E. BARNARD.

Mr. Hamilton, August 30, 1895.

[FROM THE CHICAGO DAILY INTER-OCEAN.]

THE YUKON RIVER.

"THE mother of gold" is the name Humboldt gave Alaska, and the latest news from its shining shores confirms the fact anew. Not the least part of the cargo of a Chicago-owned merchant ship, just in from the Arctic circle, was gold dust. Mr. C. A. Weare tells the particulars, as also other interesting points of the trip, which he made as an officer—treasurer—of a trading company which has for the past four years carried on an active commerce with those northernmost territories of Uncle Sam.

"I have only within the hour arrived from Alaska," said Treasurer Weare to the reporter. "I left Seattle, Wash., for Alaska on Wednesday, June 5, on the steamer Excelsior. We had aboard the ship about 550 tons of freight and sixty-odd passengers, besides our coal—she carries 350 tons of coal. We made the passage out through the Sound, the Straits of San Juan de Fuca, and made due southwest to the lower end of the Aleutian Islands, and thence through the Unimock Pass, touching at Dutch harbor, among the Alaska islands. That is the last port of entry where a United States custom house collector is stationed. Our course taken then was north through Behring Sea. We passed Pribylov Island, Nunamac Island, St. Matthew's Island and St. Lawrence Island.

"Bending our course to the north Arctic coast, of which the initial point is Cape Hope, from that vicinity we directed our ship due east along the north Arctic coast, traversing Norton's Sound, passed Cape Darvy, and thence round to St. Michael's harbor, on St. Michael's Island. There the steamer P. B. Weare met the ocean steamer, and the two vessels exchanged cargoes, we giving them provisions and merchandise of divers kinds and receiving in our turn the yellow fruitage of the mines in gleaming gold dust, and, of course, great treasures in furs.

"The P. B. Weare is the company's steamer, which plies the great inland sea of the Yukon River, one of the mightiest waterways of the globe. The river gets into St. Michael's Harbor by passing over, literally overflowing, the continuous sand bars that seek to shut up the river, the overflow skirting the western Alaskan coast for about eighty miles, between Romanoff Point and Stewart's Island. That is the way the company's boat gets out from the Yukon River and gets back into it. When the boat is once in the Yukon River it makes the passage of about 1,700 miles up the river to the different posts along it, among them the Catholic and Russian missions, Circle City, forty miles, and lastly, Fort Cudahy, fully 1,700 miles up the river.

"The object of our trip and of those investments there is to trade on this river with the miners and the natives. These are the newly discovered gold fields of Alaska, where the development, of course, is as yet more or less crude, but still very rich. There wintered in the Yukon Valley about 1,500 miners last winter, and probably the men will be increased to at least 2,000 during next winter.

"The process of obtaining the gold is by placer mining, and is done in the summer months in the usual way by sluicing. The entire country is covered by a growth of moss, which all has to be stripped off and the earth thawed down to the pay rock. Of course, during the summer months the sun will thaw the earth where the creek beds are shallow enough, but a great deal of fire and burning has to be resorted to in order to get down where the earth is deeper over the surface of the pay rock. There is a great deal of convenient timber on the Yukon River and its tributaries, mostly fir, pine and cotton, three-foot logs being about the largest. There is a sufficient quantity for all the needs of the present.

"The Yukon River is navigable for about 1,800 miles for steamboats. It has five outlets, and yet, as I have intimated, no direct, practicable channel to the ocean has been discovered heretofore, its mouth at this season of the year being, for about forty miles, filled with bars and islands. For some 600 or 800 miles up the river the water is very deep, and would be navigable by middle-sized ocean steamers if there were any way to get over the sand bars at the mouth. The river averages from one mile to ten miles wide for 800 miles, and above that it averages about one and a half miles wide for the next 800 miles. The waters of the Yukon drain a country in extent as large as the United States east of the Mississippi River. The country is mountainous, but the mountains are not very high. They have evidently been ground off by the glacier period in those canons. The valleys are filled in with these washings from the mountains, and it is in these canons and valleys that the gold dust is found, along the sides of these hills and mountains. It is found everywhere along the Yukon River and in the sands of the river. It is estimated that about \$2,000,000 to \$3,000,000 of gold dust has been taken out of the Yukon River in the past five or seven years, but a record of it does not appear in the public record, for the reason that the miners bringing it out, as a rule, go to the first assay office and pass it through and sell it, without mentioning where it is from, and the Yukon never gets the credit for it. Usually this country, where the mine or assay office is situated, is the country that gets credit for the production of that gold. I mention this because it looks to a person who is interested in that country that the United States government is not fully alive to the situation and to the magnitude and value of the country that we own there. The Canadian government is fully alive to the situation, and has already placed officers, among whom is a magistrate, with a mounted police force numbering twenty-two men, to look after the people of the Canadian government in the Yukon country. The dividing line between the British country and the United States on the Yukon is a little southeast from the Arctic circle, so that a good deal of the valuable gold country lies not only in the United States, but in the British Northwest.

"I look for a great future when the country is opened. Of course, it is now very new and crude, and the kind of people who are needed to develop it are sturdy miners who have some money to take with them, so that in case they do not happen to get a good 'prospect' immediately, they will have something on which to depend. It won't do for the ordinary run of humanity to go into that country without money.

"The country produces gold and furs in quantity. We brought down our usual collection of the latter, such as bear skin, marten, sable, silver fox, cross fox, and red ox, beaver, otter, mink, lynx, and on the coast quite a quantity of hair seal are taken, this being too far north for the fur seal.

"Another matter which should be of great interest to the people of the United States is the opportunity offered for the fishing industry along not only both sides of the Aleutian Peninsula, with its myriad islands, but the entire western and northwestern coast of Alaska, from Norton Sound to the mouths of the Yukon and the Koskoquin. There are fishing banks, both of cod and halibut, extending through the entire district mentioned and all the rivers running into these different islands and coasts at the proper season of the year are full of salmon. The natives of the Yukon country consume salmon as their principal diet, and upon it even feed their dogs. Their dogs are their beasts of burden. They do their traveling in the winter, over the snow or ice; they dress in skins; in fact are Eskimo. The Indians of the northern Arctic coast and the lower Yukon River are short, fat, sturdy people, good natured, and usually honest, while the Indians of the Yukon River are more genuinely Indian —short, slight in build, an active, hardy race, and yet, from the nature of their food—mostly fish, with some game—of course, are a species of Eskimo.

"It would be greatly to the advantage of the United States government that more interest be taken in that country, and that a proper survey be made of that great river and its mouth, as also of the proper line between the British Northwest and our Alaska.

"At Fort Cudahy, Alaska, they have six months night and six months day. At the mouth of the river they have about twenty-two hours day and two hours of twilight. During the twilight it is as easy to write as during most any of our sunshiny days, so that there is at this season unfailing light on the Yukon River, as well as on the northern part of Behring Sea. The scenic effects are indescribably fine. On June 23, when we were seventy-five miles northwest from Unimac Island, the sun set at 11:35 o'clock at night and rose just an hour and a half later, at 1:05 o'clock

in the morning, and in the darkest moments I wrote a letter with ease, and people all about me were reading. Of course, at about this time you could see the sun, moon and stars—the most magnificent evening star you ever saw—all at once, and the lights on the water were marvels. Unfortunately we had no kodak to imprison the beautiful picture. Along the Yukon, too, the scenery is very grand, as are the opportunities for fishing and hunting. My brother, E. E. Weare, who left Seattle for Juneau, Alaska, May 18, and will return to Chicago October 5, reached his destination, and then left for Deya, at which point they made a portage, then scaled Chilkat Pass, eighteen miles up in the mountains, then in eleven miles reached Lake Lindiwan, one of the head waters of the Yukon, where they built their boat and sailed right down to the great river—a trip full of romantic interest. The thermometer July 4, at the mouth of the Yukon, was 58°, and along the river it ranges in summer from 40° to fully 100°. In winter it runs from 20° to 75° below, and yet people, by providing for it, live comfortably; they of course dress and feed for it. The snows are not very great and there is very little sickness—a poor place for doctors. For a hardy person the trip is a very pleasant one. It would not do for women. I would not recommend it for any woman.

"We usually make two trips a year from Seattle to the mouth of the Yukon at St. Michael's Island, and our river boat makes three round trips on the river to and from Fort Cudahy, our headquarters."

THE COMMERCE IN VEGETABLE OILS.

By P. L. Simmonds, F.L.S.

All plants do not yield oil, but still the list of oil producers is an extensive one. The richest are the cruciferous tribe, and some of the palm fruits. All oils are not good for food or light, some of them being what are termed "drying oils."

The quantity of oil yielded varies, not only in different species, but according to climate and culture. Roughly it may be assumed that oily nuts yield half their weight; colza seed two-fifths, hemp seed one-fourth, and linseed from one-fourth to one-fifth.

Some oils are employed for food, others are burned in lamps; some form the basis of soap, or are used as lubricants, not to mention their employment in painting, in perfumes and many other economic purposes.

In the manufacture of woolens from 10 to 15 per cent. of oil is required. For the finer kinds of wool, olive and ground nut oils are used, while for the coarser kinds rape is employed.

The largest source of vegetable oils is the small seeds of plants, and some of them are used for food. The seed of the cotton plant, gingilie, mustard, linseed and rape seed may be quoted as illustrations of those products, and oils of a very fine quality are procurable from them. The seeds of the common cucumber and those of other cucurbita may be especially cited as yielding an edible oil of delicious and delicate taste, and that of the large cucumber, grown on the slave coast, far exceeds in flavor the finest olive oil.

Seed oil is more commonly eaten in India and other hot countries than in England. The seeds of the safflower and the sesamum oils may be added to the list, as representing Indian oils, which are used in cooking grain and other vegetables; while in the gloomy forests of Central Africa and in the great mangrove swamps, where the cassava, plantain and yam are the chief foods, palm oil and vegetable fats are almost necessaries of life.

In a work which I helped Dr. Edward Smith to bring out some years ago, "On Foods," he observes: "There can be no doubt that we have in this product of seeds of plants, which seem otherwise to be useless, a great storehouse of most valuable nutritive material; and if we know but little of many of them in this climate, it is because we have the olive oil at hand, and are bountifully supplied with many kinds of animal fats. It is, however, probable that the cheapness of some of these vegetable oils, in addition to the delicacy of their flavor, will, ere long, force themselves into notice and obtain a place among our foods."

In China there are a number of edible oils used which do not appear in English commerce, and they have even some mode of purifying castor oil to remove its drastic properties. The enormous demand for oil there, as an article of daily diet, to counteract the binding qualities of rice and other cereal foods in pastry making, etc., has led to the manufacture of oil from all sorts of sources.

Vegetable fixed oils are usually contained in the seeds of plants, though olive oil and palm oil are extracted from the pulp which surrounds the stone. They are commonly of a thickish consistence and unctuous feel, and differ from volatile oils in leaving a greasy stain on paper, which cannot be removed by heat alone. They are sometimes colorless, occasionally of a greenish or yellowish hue; when pure, semi-transparent, with little smell and a mild taste.

Fixed oils are those which require an intense heat before they give out vapor. The fixed vegetable oils are chiefly expressed, the seeds or raw material being previously ground or bruised, and the pulpy matter subjected to pressure in hempen bags; a gentle heat being generally employed at the same time, to render the oil more liquid. Those which retain their transparency after they have become solid, as linseed, nut, poppy and hemp seed, are called drying oils, while others which assume the appearance of tallow or wax and become opaque, as olive, almond, rape and benne, are called fat oils.

The former are mostly used for paints, varnishes and printers' ink; the latter are consumed as food, in medicine, soap making and other branches; several of each kind being likewise extensively employed in the arts and in the lubrication of machinery. The division of oils into drying and non-drying is due to the oleine which alters in oxidizing. The product of this alteration is, in non-drying oils, an acid of a disagreeable odor, which irritates the throat; in the drying oils it forms an actual resin.

India and Africa are the chief producing countries of oil-yielding plants. There are over 300 plants known in India to yield oils or perfumes, while those of many other countries also furnish fixed or volatile oils. Some are, however, not articles of any commercial importance.

The port and town of Marseilles, from its facilities for obtaining supplies from Africa and India, is regarded as the principal European center for oil crushing and the utilization of oils.

The receipts of oil seeds and their manufacture at Marseilles, in 1887 and 1893, were as follows, in metrical quintals of 2 cwt.:

	1887.		1893.
	Oil Seeds.	Oil Made.	Oil Seeds.
Ground nuts	785,280	265,000	1,225,290
Castor	214,090	88,000	12,820
Colza	42,830	5,700	54,100
Copra	71,650	100,000	466,340
Cotton	236,960	46,800	182,170
Linseed	73,400	20,500	108,490
Mowra (Basin)	52,000	19,300	120,390
Niger	6,850	2,050	19,940
Palm nuts	300,000	132,000	168,060
Poppy seed	46,050	17,000	36,890
Ravisons (mustard)	12,780	600	12,000
Sesame	878,630	396,000	1,188,460
Other seeds and oleaginous fruits	47,050	——	208,900
	2,867,660	1,121,400	3,803,790

The stock of oil seeds on hand at the end of the year 1892 was	35,000	metrical	quintals.
Received in 1893	3,803,790	"	"
	3,838,790	"	"
Deducting the stock in hand at the close of 1893	40,000	"	"
	3,798,790	"	"
The mills at Marseilles crushed	3,260,000	"	"
Being an excess over 1892 of	538,270	"	"

These oil seeds produced	151,195,000	kilogrammes of oil.
To which has to be added imported from various countries, which	12,698,000	
represents a total of	163,893,000	" "

The average imports of oil at Marseilles, in each of the five years ending 1893, was 27,643,400 kilogrammes, and the average annual exports in the same period was 38,923,200 kilogrammes (of 2⅕ pounds) per annum.

The progress of the trade in oil seeds and oil at the port of Marseilles has been enormous in the last twenty-five years, and has advanced from 184,986 tons of all kinds in 1870 to 380,279 tons in 1893, of 20 cwt.

The fixed or expressed oils imported into the United States were, in 1890, 20,323,677 pounds free, valued at $1,437,216, and of other oils, dutiable, 687,797 gallons, value, $417,388. In 1894, olive oil was imported to the extent of 21,173 gallons, value, $23,262, and other fixed oils, 45,470 gallons, value, $28,308, dutiable. The volatile or essential oils imported in the States in the last ten years were:

	Pounds.	Dollars.
1885	4,594	10,184
1886	3,539	19,917
1887	2,290	6,546
1888	4,880	7,776
1889	53,874	10,375
1890	19,707	10,018
1891	74,972	12,765
1892	19,080	10,233
1893	80,320	16,981
1894	16,863	9,252

The exports from China were fixed oils (which include benne oil, ground nut, tea seed and wood oils), as follows, in piculs of 133⅓ pounds:

	Fixed Oils.		Volatile or Essential. (Aniseed, Cassia Leaf, etc.)	
	Piculs.	Value.	Piculs.	Value.
1889	43,390	£61,000	2,074⅓	£51,943
1890	49,642	70,680	2,207⅓	55,153
1891	41,589	62,109	2,174⅓	62,300
1892	44,062	55,551	3,168	83,045
1893	152,069	200,557	2,273⅓	57,623
1894	196,928	162,965	2,085⅓	75,688

From British India the fixed oils exported are chiefly castor oil, 3,000,000 gallons yearly; cocoanut oil, 1,500,000 gallons; a small quantity of til, or gingilie (sesame), 250,000 gallons; and of other kinds of oil, about 300,000 gallons. The volatile or essential oils exported from India are now about 18,000 gallons, valued at £44,000.

The specific gravity of oils has been carefully determined, and is of some consequence. To be of value, the specific gravity should be carefully taken at a temperature of 60° Fah. The oliometer should be marked with ordinary specific gravity degrees, water being 1,000, and the face allowed on the stem for each degree should not be less than one-tenth of an inch. As a rough rule, 1° of gravity may be substituted for every 2½ per cent. excess of temperature above 60° Fah.

ILLUMINATING OPAQUE OBJECTS FOR THE MICROSCOPE.

With very high powers this has hitherto been almost impossible; but, at a recent meeting of the Paris Academy of Sciences, M. Marey, of instantaneous photography fame, in the chair, M. Ch. Fremont described a novel and extremely ingenious method of carrying out the desired end. Inside the body of the microscope is fixed a concave mirror, which reflects the bundle of rays of light received through an aperture in the side, and rendered parallel by an interposed prism, through the object glass, on to the object under examination. It will at once be asked how the eye, and at the eyepiece end, can see the object. This is ingeniously provided for by the simple expedient of boring a hole through both mirror and prism in the track of the rays passing from the objective. The chairman said he anticipated great use from the contrivance in the chromo-photographic study of the movement of microscopic beings.

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